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Here and There

In the "Katy Shops"

By Frank W. Curtis
Western Editor, *American Machinist*

LOCOMOTIVE repair affords the opportunity of applying many practical shop kinks inasmuch as the work is of such a varied nature. Unlike other fields of manufacture, the railroad shop generally is presented with odd jobs that require handling in an original manner to suit the available equipment. The operations illustrated are some of the recent ideas that have been worked out at the Parsons, Kan. shops of the Missouri-Kansas-Texas R.R. Co. for handling miscellaneous work.

One of the problems that heretofore caused trouble is the grinding of the equalizer-cylinder bushing of triple valves. The bushing is made of bronze and requires an accurate finish so there will be no lost air pressure between the piston and bushing when they are fitted together. It is necessary to have the inner surface of the bushing concentric with the center-shaft bearing, therefore, the finishing operation has to be handled at assembly. The grinding-in attachment shown in Fig. 1, devised for performing this operation, comprises a shaft that has a hardened pilot at the front end which fits into the small bushing of the work. To the rear of the pilot is mounted an expanding split sleeve that fits over a tapered collar fastened to the shaft. The front end of the collar is located against a stationary pin in the shaft, while the rear end of the sleeve has a sliding collar adjacent to it as shown. As the nut is tightened the sleeve expands accordingly. The outer surface of the sleeve is fitted with a narrow strip of abrasive cloth, held from slipping or turning by fastening the ends into one of the slots of the sleeve. In operation the sleeve is placed into the work, then expanded to fit the bore of the cylinder bushing, after which the operator oscillates the entire unit back and forth by the handle. The high spots of the bushing are taken off after continuing the motion a short time. A smooth cylinder wall is thus produced.

The reamer set shown in Fig. 2 is used for finishing the inner surface of feed-valve piston bushings. The principle is similar to the grinding-in attachment in that the bushing is reamed concentric with the center bearing of the work. The guiding arbor *A* is made with a tapered portion in the center over which is assembled the split bushing *B*. These parts are assembled into the slide-valve bushing of the work so the threaded end of the arbor projects beyond its outer face. The washer and knurled nut are placed on the arbor, being drawn in place sufficiently to form a snug fit between the split bushing and the work. The reamer, which is provided with a pilot hole at the cutting end, then is started over the opposite end of the arbor. The reamer is made with a knurled handle so it can be turned readily as it is advanced into the work. Approximately 0.002 in. of metal is removed from the feed-valve piston bushing. As various sizes of bushings are used, the set comprises five reamers, ranging from 1.75 to 1.76 in. in

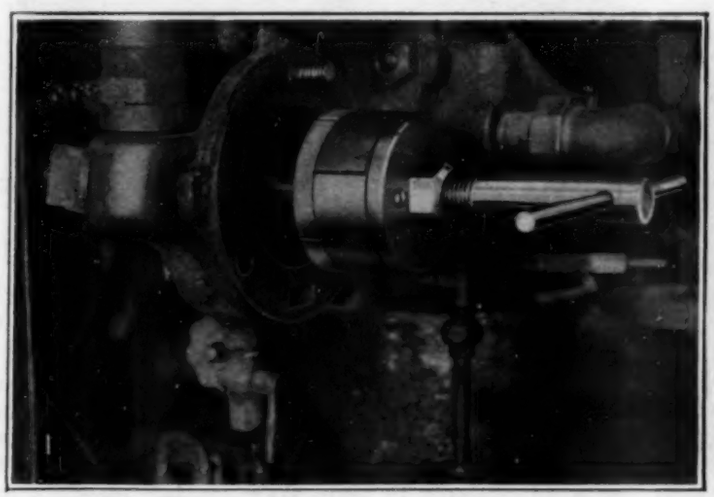


Fig. 1—Grinding in an equalizer bushing. Fig. 2—Reamers for feed-valve piston bushing

diameter. The reamers have twelve teeth cut to 45 deg. left-hand spiral.

Air-compressor pumps are dismantled and assembled on the adjustable work stands shown in Fig. 3. The stand consists of a table and an adjustable shelf that can be positioned in a horizontal or vertical plane, or any angle in between. The shelf is operated by a crank that is connected through an arm to a shaft on which is mounted a wormwheel. The wormwheel meshes with a worm that is controlled by the large hand wheel projecting beyond the rear end of the stand.

Constructional details of the work stand are shown in Fig. 4. The framework is made of 1 x 4-in. wrought iron and arranged so the table top is approximately 32 in. from the floor. Three of the stands are in use for this class of work.

The attachment shown in Fig. 5 is used for drilling, countersinking and reaming holes of boilers and fire boxes. The frame is made of two upright ends with an upper and lower brace connecting them. The operating unit is attached to the braces by rollers as shown. The vertical lead screw that is positioned between the rollers is equipped with a universal carriage on which is mounted a spindle. On the end of the spindle is attached an air motor. The carriage may be elevated to a suitable height and also may be turned to present the spindle at a desired angle to the work. These locations are locked by a binder on the carriage that is tightened on the lead screw. The spindle is operated by the hand-lever shown to the left. A counterbalance is attached to the carriage to facilitate operation. The entire unit is portable so it can be transported by crane to any desired location.

An air-operated device is used for grinding in exhaust nozzles to the saddle, eliminating the usual hand-operation. A double motion is produced as a result of the nozzle being moved forward and twisted simultaneously. Fig. 6 shows the construction of the unit. An air motor is mounted on a cross member that is clamped to the front end of the smoke box. A gear reduction drive

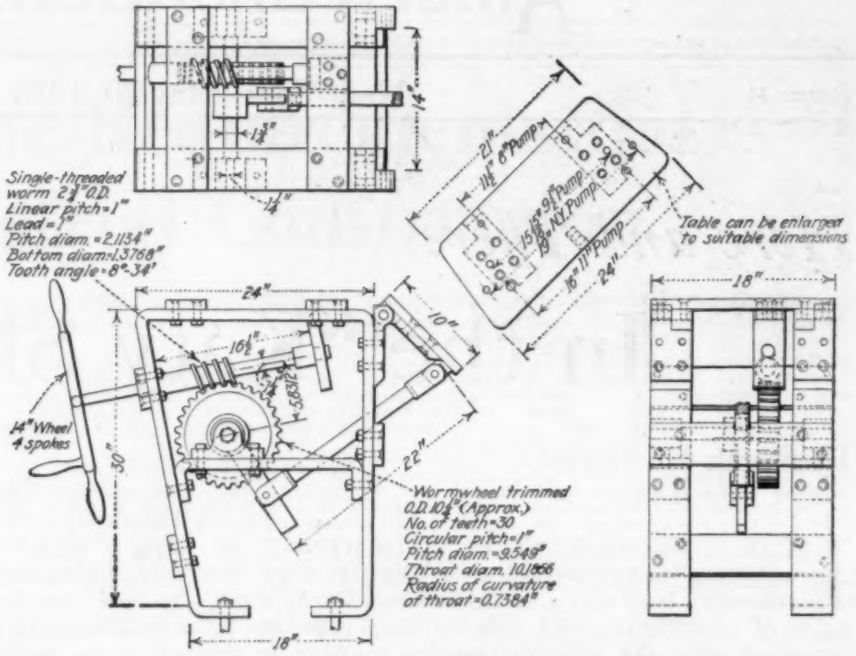


Fig. 4—Constructional details of stand

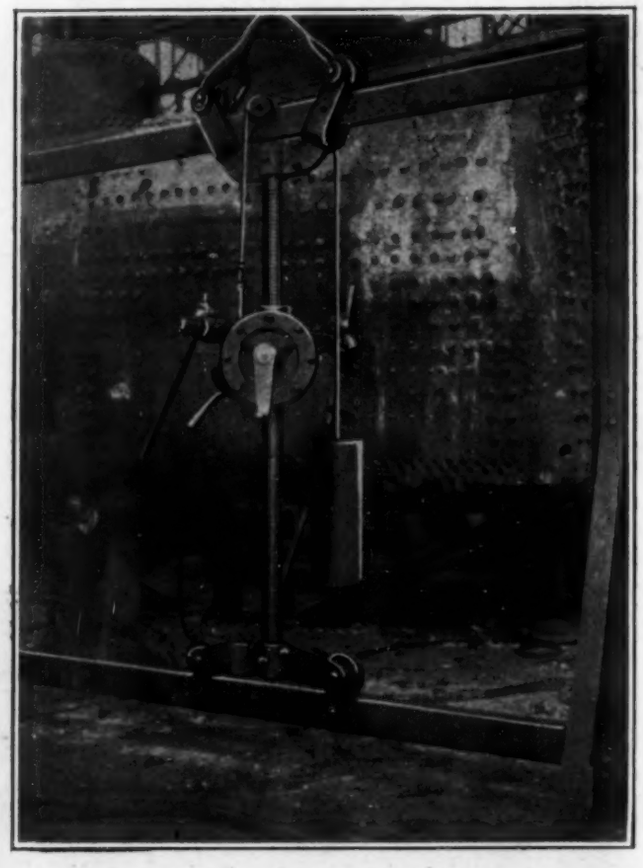


Fig. 5—Portable drill rig

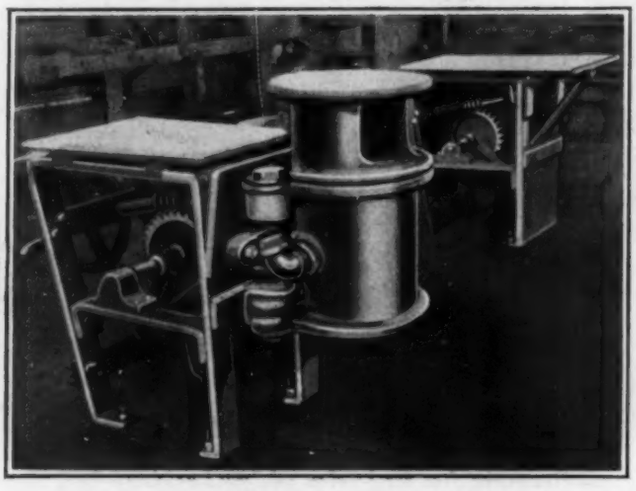


Fig. 3—Stands for air-compressor pumps

is placed at the spindle end of the motor so a comparatively slow motion may be obtained. The driven shaft is provided with two eccentrics that operate shafts attached to them. These shafts are connected to a clamp that is fitted to the nozzle. The shafts are provided with adjustments to compensate for the variation in lengths between the nozzle and the front end of the smoke box.

Fig. 6—Device for grinding in nozzle

Spring leaves are formed by the air-operated device shown in Fig. 9. The unit comprises a cast-iron plate fitted with two pins that are adjustable in their location and a 9-in. air cylinder equipped with a forming block attached to it as illustrated. The spring leaves are heated to 1,100 deg. F. for bending. The pins on the table are adjusted to suit the smallest leaf that in turn is placed against them. The forming block then is operated to bend the leaf to the desired radius. Keeping this section in place and after it has cooled off sufficiently to avoid further bending, the second leaf is placed next to it and formed in the same manner, thereby producing the same radius. The smallest leaf then is removed and the third leaf is formed over the

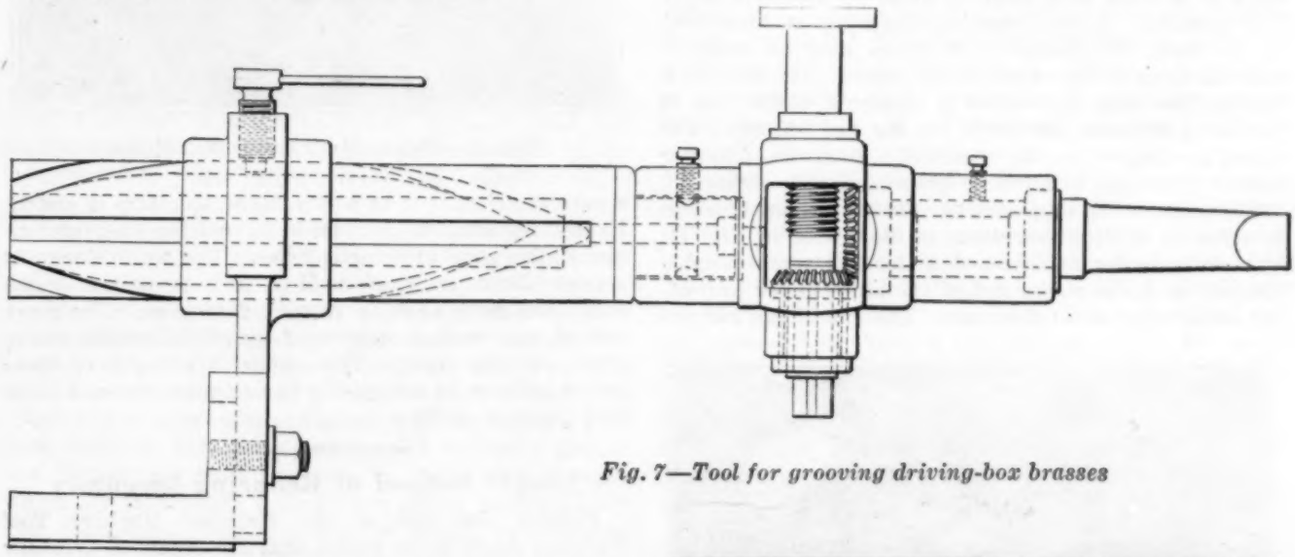


Fig. 7—Tool for grooving driving-box brasses

Oil grooves of driving-box brasses are cut with the device shown in Fig. 7. The driving box is mounted in a fixture on the drill-press table for the operation. The unit shown is attached to the spindle by a No. 4 Morse taper shank at the upper end and guided by a pilot bushing in the fixture at the lower end. A hole is provided in the machine table to allow the pilot bar to pass through it. The driven portion of the attachment has a bevel gear fastened to it which meshes with a corresponding gear that is connected to the cross-spindle. A specially formed end mill is fitted into this spindle. An adjustment is provided on the spindle so it can be set to suit the diameter of the brass to be machined. In operation the cutter is started at the top face of the brass, then as the spindle of the press is fed downward, a groove is cut in the work to correspond with the movement of the entire unit. This movement is controlled by a guide pin, located in the pilot bushing, that fits a slot in the pilot bar. Three movements are provided for cutting a straight groove and either a left- or right-hand spiral groove by setting the guide pin in the corresponding slot of the pilot bar.

Two air-operated pipe-bending attachments, such as shown in Fig. 8, are used for locomotive pipe-fitting work. The air cylinder is mounted on an upright frame so the plunger is brought in line with two adjustable work supports. A forming block to suit the size of bend is attached to the plunger as shown. The pipe to be shaped is placed on the work supports, after which the forming block is brought down a sufficient distance to make the desired bend. The units are located close to the pits to make them accessible to the workmen.

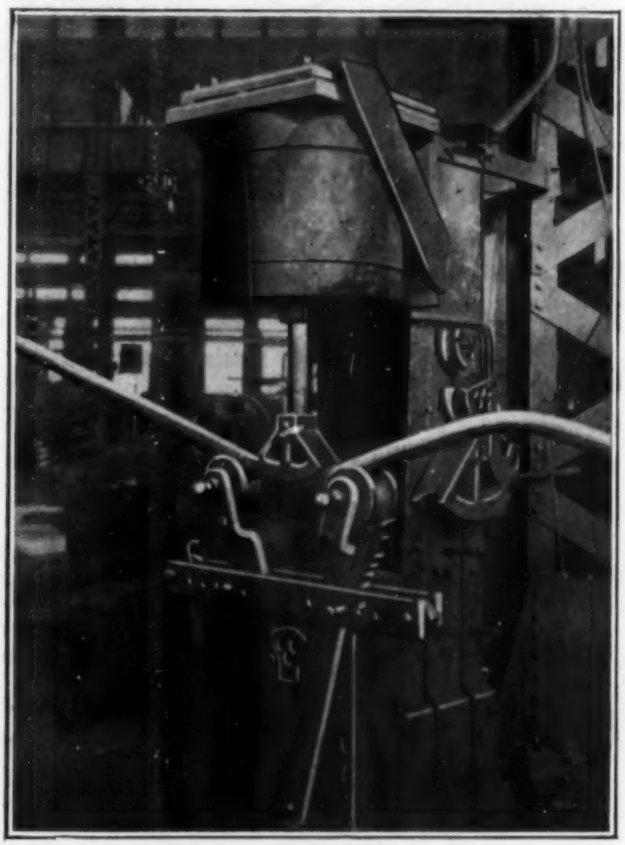


Fig. 8—Air-operated pipe-bending attachment

second leaf. The operation is continued until the entire set of leaves has been formed. It is necessary to reset the pins to a wider spread as the leaves increase in size. Approximately 70 lb. pressure is used for bending purposes. Upon completing the forming of the set, the leaves are reheated to 1,150 deg. F. and quenched in oil for a spring temper. The leaves vary in size although the majority used are $\frac{3}{8}$ in. in thickness and 6 in. in width.

Turning Packing Rings

A special mandrel is used for turning valve-packing rings, details of which are shown in Fig. 10. Four rings are machined at one setting. The mandrel consists of a steel body that is fitted to the spindle of the machine. A cast-iron locating ring is assembled in the body, the diameter of which may be made to suit the bore of the work to be turned. At the outer end of the body is located a clamping plate that is tightened against the work by the nut shown. The rings are placed on the mandrel and drawn together tightly by a band before the clamping plate is tightened.

Throughout the shop may be seen air-operated clamps attached to drilling machines, as illustrated in Fig. 11. The air cylinder is fastened under the machine-table support with the piston rod of the air cylinder projecting above the face of the table. The end of the rod has

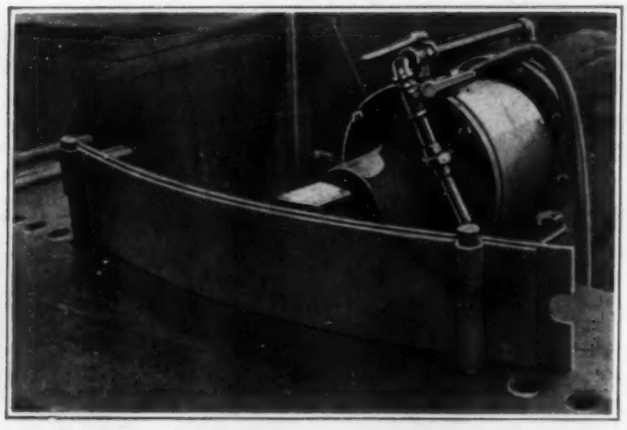
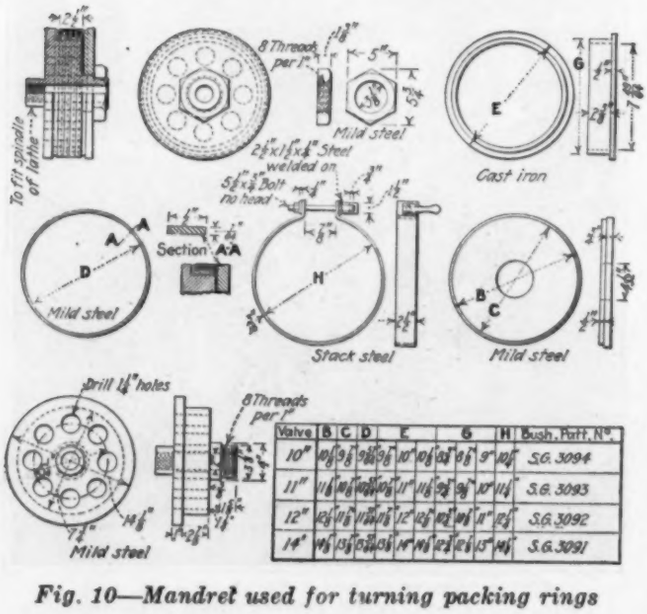


Fig. 9—Forming spring leaves



Valve	B	C	D	E	G	H	Bush. Patt. No.
10"	10⅝"	9⅜"	9⅜"	10"	9⅜"	9"	S.G. 3094
11"	11⅝"	10⅜"	10⅜"	11"	10⅜"	10"	S.G. 3093
12"	12⅝"	11⅜"	11⅜"	12"	11⅜"	11"	S.G. 3092
14"	14⅝"	13⅜"	13⅜"	14"	13⅜"	13"	S.G. 3091

Fig. 10—Mandrel used for turning packing rings

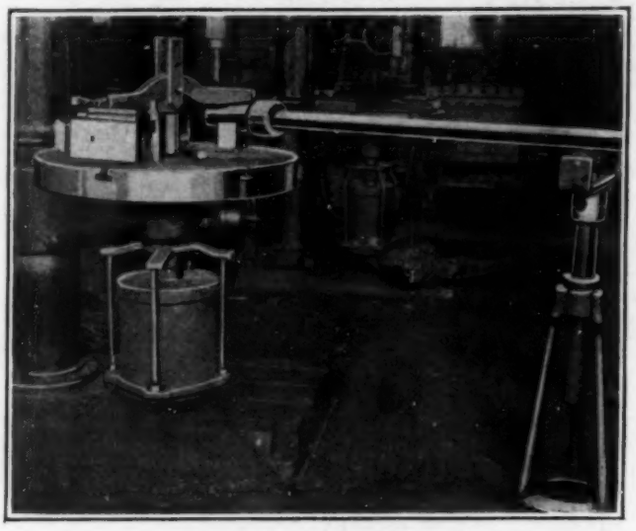


Fig. 11—Pneumatic clamp on drill press

a yoke attached to it in which the strap clamp is placed. Height adjustments are made by placing the fulcrum pin of the yoke in various holes. The work shown is a brake beam in which a $\frac{13}{32}$-in. hole is drilled at one end. The machine is an Aurora drill press. The outer end of the work is supported by an adjustable stand shown to the right. The clamps are rapid in their action and can be set quickly to suit miscellaneous work that requires drilling.

Simple Method of Reducing Inventory

Bulletin No. 416 of the National Machine Tool Builders Association states that the Pratt & Whitney Co. has reduced the number of sizes of various items carried in stock by a simple and effective plan. The table below illustrates how the plan was applied to screw sizes.

The standard lengths are listed in the left-hand column, and across the top are listed the standard diameters as column headings. Every alternate space is checked out, and the check-outs are staggered. Only the items denoted by the blank spaces are carried in stock; hence the stock is reduced to one-half its former value.

Table of Selected Screw Sizes

Length In.	Diameter, Inches						
	¼	5/16	3/8	7/16	½	9/16	5/8
7/16	X		X		X		X
½		X		X		X	
9/16	X		X		X		X
5/8		X		X		X	
11/16	X		X		X		X
¾		X		X		X	
13/16	X		X		X		X
⅞		X		X		X	
15/16	X		X		X		X
1		X		X		X	
1⅛	X		X		X		X

The designer, in choosing a size, may find that he wants a screw $\frac{3}{8}$ in. in diameter and $\frac{13}{16}$ in. length. This size is checked out in the table. He must then decide whether the diameter is more important to retain than the length, or whether the reverse is true. If the former condition prevails, he selects either the $\frac{3}{4}$ in. or the $\frac{7}{8}$ in. lenth; if the length must be maintained, he has a choice between $\frac{7}{16}$- and $\frac{1}{2}$-in. diameter screws.

This method gives him four choices, and there are not many cases where one or the other of these four choices will not serve all practical uses.

American Industry and Legislation

By James A. Emery
General Counsel, National Association of Manufacturers

So many laws are being passed each year that we are in danger of being overwhelmed — Legislation is not a panacea for economic ills

THE soundness and stability of American public policy bears an intimate and vital relation to the progress and prosperity of our industry. In foreign relations it is expressed through treaties and executive action; in domestic affairs through local and national legislation, which in its turn is colored by the interpretation and enforcement of administrative bodies.

During the past quarter century, in particular, whenever anything goes wrong legislation, in large or small doses, has become an accepted remedy. "We do not give ourselves time," declared a distinguished member of the Senate, "to study the conditions or consult the precedents so as to determine whether the symptoms point to a serious disorder or mark a mere irregularity in an otherwise normal and healthy development, or, indeed, whether they simply indicate a perfectly proper but unfamiliar condition, due to the great changes which are continually taking place in our modern life." But, quite apart from its merits or defects in form and substance, the rising tide of actual and potential legislation threatens the business life of the United States with a flood of restriction which annually becomes increasingly extensive, complicated and expensive.

The Evil of Over-Regulation

Among other characteristics, the overwhelming volume of American regulation is in itself a serious evil. Dr. Dicey of Oxford observes that Congress and the states annually enact more legislation than is proposed for the collective consideration of the parliaments of Great Britain, Germany, France, Austria and Italy. It must be observed that we possess unusual plant facilities for quantity production. In addition to a headquarters staff of more than five hundred members of the Congress, which has remained in almost continuous session for several years past, we maintain branches in forty-eight states, employing more than four thousand operatives, while a numerous host of aldermen, supervisors, trustees and selectmen man the subsidiaries in more than 16,000 incorporated cities and towns and 3,000 counties. Bills, the raw material of legislation, pile up in the national and local law shops annually in numbers which easily reach into six figures. Exclusive of municipal and county ordinances, the statutory production of Congress and the states has approximated 12,000 yearly during the past decade.

Competent authority assures us that we now live, in federal and local government, under the daily operation of more than a million and a half enactments. Each of these, in turn, may prescribe simple or complicated regulations. "The laws of the forty-eight states in 1923," says a former Solicitor General of the United States, "filled 5,567 volumes of 1,192,000 pages." "A well-informed police officer needs a working knowledge of not less than 16,000 statutes and ordinances which he is presumed to aid in enforcing," remarks a reliable authority upon administration.

Custom, the foundation of law and the basis of conduct, is lost. The individual and the corporate organization, with reference to person or property, is less and less able to determine rights and duties readily by turning to fixed rules. With the steady enlargement of administrative law they must with increasing difficulty and expense undertake to conform conduct to the probable viewpoint of an increasing number of boards and commissions. These, in their turn, steadily multiply in number and authority until the Secretary of Commerce informs us that not fewer than two hundred are scattered through the Government departments, while not fewer than forty operate independently.

Legislation for the Majority

Legislative activity, particularly in social questions, is greeted with satisfaction by many who, dissatisfied with the slow but permanent influence of education, religion and the councils of the fireside, see progress stimulated by enlarging the sphere of government. They would have the state interfere, not whenever it must, but whenever it can. There are, in addition, well-organized minorities who seek on every occasion to impose their will upon their fellows, or with the aid of a statute to experiment with their liberty or property.

It is worth while to keep the following points in mind:

1. Legislation writes rules for the millions, and litigation, however, important, affects but a limited number. The quantity and quality of government intervention is a business study of the first importance.

2. Committees of the state and national legislatures are the cradles or the graveyards of legislation. Industrial executives should be prepared, when important measures are under consideration, to give such committees the benefit of their special knowledge and experience. Morover, by timely, well-informed discussion with their representatives before the bodies to which they belong convene, when legislators have the time, and generally the desire, to obtain accurate information respecting pending proposals, business men make a helpful contribution to sound political thinking. Home is a better forum than Washington.

3. Many states are re-examining their constitutional structure. Some, like Maryland, are reaching the conclusion that less frequent sessions of the legislature

would save no inconsiderable public expense and lessen the volume of legislation. Is Georgia, with an annual legislative expense of $135,000, better governed than its neighbor Alabama, with a larger population, an annual legislative expense one-third that of Georgia and a quadrennial assembly? Is it not worth while for the people to consider whether states enjoying annual sessions of the legislature might with profit make them biennial or quadrennial?

4. Sound local government is the foundation of all good government. If, in the reorganization of their political framework, the states which hold elections in even years would change them to odd years, the confusion between local and national issues would be ended. How much could be gained for good government if we corrected that unhappy condition which too frequently permits local questions to be badly decided and bad candidates to be elected under the dominating influence of some overshadowing national party issue!

5. How great would be the gain if business leadership would ardently join in directing public attention to the demoralizing and unnecessary multiplication of regulation which, in the language of Phillips, "kills all self-help and energy of the governed." How important it is, in the sobering administration we at present enjoy, to recall to our people the importance of again realizing in our every-day life the limitations which Lincoln, with his usual clarity, placed about the intervention of the state. "The legitimate object of government," he said, "is to do for a community of people whatever they need to have done, but cannot do at all or cannot so well do for themselves in their separate and individual capacities. In all that the people can individually do as well for themselves government ought not to interfere."

Liability of Manufacturing Plant for Injury to Leased Premises

By Leslie Childs

BY THE very nature of a manufacturing business, it may require the installation of fixtures of a heavy character securely attached to the premises. It follows, if the premises are merely leased, that the question of the liability of the lessee for injury to the premises, caused by the removal of the fixtures, may easily arise. Situations of this kind are frequently met in the heavy manufacturing field, especially in the iron and steel industry, and they are deserving of careful consideration by executives when leases are being written, and fixtures are being installed under the terms.

As an illustration of the possible danger to a firm in overlooking the point involved, the Washington case of Delano vs. Tennent, is worth examination. In this case the defendant operated a foundry on leased premises. By the terms of the lease the lessee was required to take the buildings on the premises as they were, and to surrender them at the end of the term in as good condition. The lessee also agreed to bear the expense of making changes, additions or repairs to the buildings.

After the defendant took possession of the premises he erected a number of structures in the form of additions to the main buildings, and one building was erected which was not joined to the main building. He also installed a core oven, an electrical transformer, a jib crane, and a hoist. The floor of the main building was made of clay several inches thick as a protection against fires. As may be expected, these heavy fixtures were attached in a secure manner to the premises.

When the defendant moved from the leased premises, he removed the fixtures which he had installed. All of the new structures were torn down, the core oven and transformer were removed, and all the valuable materials salvaged, including the crane and hoist. In removing these fixtures the clay floor of the main building was partly destroyed, and the supports of the building were weakened. The destruction committed, however, was not caused by any carelessness on the part of the defendant, but was the natural result of removing the fixtures.

Following this the owner brought action against the defendant for damages for the injury to the premises. In defense to this action, the defendant contended that the structures removed were not of such a permanent character that they could not be removed within the term of the lease. In other words, the defendant took the position that in removing the fixtures he had not gone beyond his legal rights in the matter. The trial, however, resulted in a judgment against the defendant in the sum of $1,620. From this the defendant appealed to the higher court, and the latter, in reviewing the record, affirmed the judgment of the lower court, arguing in part as follows:

"It is argued that the structures destroyed and removed were not of such a permanent nature that they could not be removed during the time of the lease. But we think they were so both under the general rule and under the covenants of the lease. They were so far a part of the building that they could not be removed without material injury thereto, unless the lessee intended to and did inflict a willful and wanton injury to the premises, an accusation which he denies, and an accusation of which we willingly acquit him.

"Again, by the covenants of the lease, the lessee agreed to surrender the premises at the termination of the lease in as good condition as they were at the time of the execution of the lease. This clause of the lease required the tenant to leave on the premises all additions to the main building, and all structures in the nature of trade fixtures, which could not be removed without injury to the building or without lessening its value, and certainly included all of the fixtures and structures that are here in question."

The foregoing case obviously carried a worthwhile point on the question decided for executives of heavy manufacturing plants operating in leased premises. For as a general rule leases of property of this kind, not to mention the general rule on this subject, carry a provision that requires the lessee to leave the premises in as good condition as they were found. In view of which ponderous fixtures that are firmly attached to the premises, and that obviously cannot be removed without injury to structures to which attached, should not be erected without due consideration of their after disposition.

The Relation of Load to Wear on Gear Teeth

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Experiments show that in order to transmit power without appreciable wear the maximum specific stress given by the Hertz equation should not exceed the elastic limit

ONE of the first problems that required a solution for the proper design of gears was that of the strength of the gear teeth. Today, the Lewis formula is extensively employed for this purpose. This formula established safe working loads that will not break the teeth of the gears.

Today we are faced with an additional problem that requires a similar solution. The requirements that gears must meet have become more and more severe. We are seldom troubled with the breaking of gear teeth, but often find that the gears are wearing too rapidly. Although we have thousands of installations in service, the several factors involved are so different that we are unable to draw any useful conclusions from such data until we can establish some method of reducing this data to a common basis of comparison. In other words, we need a "yard-stick" in order to make useful comparisons on the wear on gears. The purpose of this paper is to suggest a form for such a yard-stick that will assist us in the absence of more exact knowledge.

The results of several interesting experiments on the wear of gear teeth have recently been published. One of them, by E. R. Ross, was presented before this association in the fall of 1921. Another, by Prof. C. W. Ham and J. W. Huckert, was published in July, 1925, by the University of Illinois. A third, by Prof. Guido H. Marx and his associates at Stanford University, was presented before the American Society of Mechanical Engineers in December, 1925. All of these investigations dealt primarily with the rate of wear on the tooth profiles, and the tooth pressures were sufficiently high to obtain this wear after a comparatively few hours' run.

As producers of gears, however, you should not be so much interested in how fast a gear tooth wears, nor to what shape it wears, as you should be interested in knowing the maximum loads you can impose upon the gear teeth without obtaining any appreciable wear. In this respect, gear tooth wear is very similar to the wear on plain bearings. The rate of wear on bearings is a secondary matter; the essential thing is to establish reliable pressure and velocity relationships such that wear to any appreciable extent does not take place. Once wear starts, the further useful life of a bearing is very short. The same is true of gears. I think you will find that the much greater portion of the total useful life of a worn-out gear was without appreciable wear. We should search, therefore, for some method of determining the pressure and velocity relationships on gear teeth that will result in negligible wear for long periods.

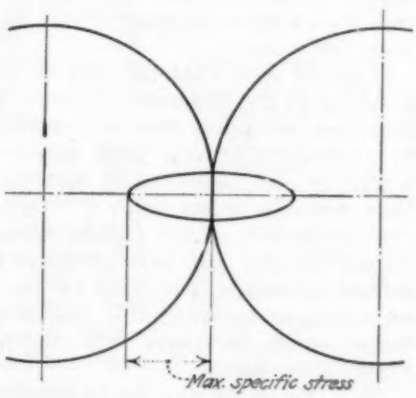


Fig.1

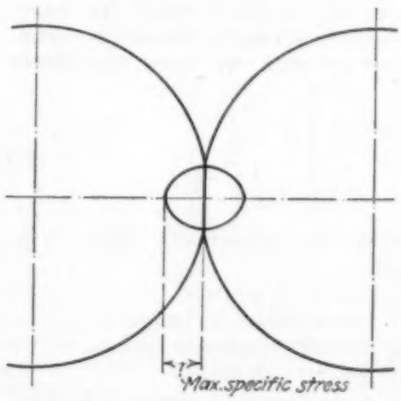


Fig.2

Fig. 1—Stress distribution with two hard metal cylinders in contact
Fig. 2—Stress distribution with two soft metal cylinders in contact

Contact between gear tooth profiles is similar to that between two cylinders, except that on the former, the radius of curvature is constantly changing. Therefore, if we use the contact and pressure conditions between two cylinders as a measure of similar conditions on gear teeth, we must first establish some definite part of the gear tooth profile as a basis of comparison. Such a method of comparison has been suggested by Charles H. Logue in the *American Machinist Gear Book*, published in 1910.

In many cases, wear on gear teeth becomes apparent first at or near the pitch line. Why this is so is still somewhat of a mystery. Possibly one contributing cause is the fact that at the pitch point, one tooth is usually carrying the entire load, while at the top and

Paper presented at the annual meeting of the American Gear Manufacturers' Association, Detroit, Mich., May 14, 1926.

bottom of the active profile, two teeth are in engagement. But whatever its cause, this fact justifies us in selecting the radius of curvature of the gear tooth profile at the pitch point as the one to use as a basis of comparison.

We will now turn our attention to the contact and pressure conditions that exist between two cylinders. Where two cylinders with parallel axes are brought together, contact takes place along the line which is composed of the points of tangency of the two cylinders, or along the tangent elements of the two cylinders. When pressure is applied, and since the cylinders are made of elastic material, this line broadens out into a surface and the cylinders are distorted. The greater the pressure, the wider this surface will be. The pressure between the surfaces thus created is not uniformly distributed. The pressure is greatest where the distortion is greatest, or along the line where contact first existed. The pressure is zero along the line where the contact stops. This condition is illustrated in diagrammatic form in Fig. 1. The distances along the X-axis represent the intensity of pressure between the surfaces at the different places. The area under the curve represents the total pressure applied to the two cylinders. These pressures, or compressive stresses, are equal and opposite at all mating points of both surfaces.

If a second pair of cylinders of the same size but of softer material—that is, with a lower modulus of elasticity—were in contact under the same pressure as before, the contact surface between them would be broader. As a result, with a broader base but the same area, the height would be shorter. This is illustrated in Fig. 2.

Maximum Specific Stress

It is not the total pressure or stress that we are interested in, but rather the maximum stress at any point that results from a given pressure. This stress is known as the "Maximum Specific Stress." To determine this maximum specific stress between two cylinders in contact under pressure we have the Hertz equation as follows:

$$S^2 = \frac{0.35P\left(\frac{1}{R_1}+\frac{1}{R_2}\right)}{L\left(\frac{1}{E_1}+\frac{1}{E_2}\right)} \qquad (1)$$

where S = maximum specific compressive stress, in lb. per sq.in.
P = load on cylinders in pounds
R_1 = radius of first cylinder in inches
R_2 = radius of second cylinder in inches
L = length of cylinder in inches
E_1 = modulus of elasticity of material in first cylinder in lb. per sq.in.
E_2 = modulus of elasticity of material in second cylinder in lb. per sq.in.

By transposing this equation, we can put it in terms of pitch diameter, pressure angle, and ratio of gears and can get some idea of the compressive stresses set up in gear teeth.

Let R = radius of curvature of gear tooth profile at pitch point
A = pressure angle
D = pitch diameter.
F = length of face of gears = L in Hertz equation
W = tooth load = P in Hertz equation.

Then $$R = \frac{D \sin A}{2} \qquad (2)$$

We can transpose equation (1) as follows:

$$S^2 = \frac{0.35W\left(\frac{2}{D_1 \sin A}+\frac{2}{D_2 \sin A}\right)}{F\left(\frac{1}{E_1}+\frac{1}{E_2}\right)} \qquad (3)$$

Solving for W, we have

$$W = \frac{S^2F\left(\frac{1}{E_1}+\frac{1}{E_2}\right)}{\frac{0.35}{\sin A}\left(\frac{2}{D_1}+\frac{2}{D_2}\right)} = \frac{S^2F \sin A\left(\frac{1}{E_1}+\frac{1}{E_2}\right)\left(\frac{2D_1D_2}{D_1+D_2}\right)}{0.35}$$

In order to simplify this equation, we will let K = stress factor.

$$K = \frac{S^2}{0.35}\left(\frac{1}{E_1}+\frac{1}{E_2}\right)$$

$$Q = \text{ratio factor} = \frac{2D_2}{D_1+D_2}$$

whence $$D_1Q = \frac{2D_1D_2}{D_1+D_2}$$

Our equation now becomes

$$W = D_1FKQ \sin A \qquad (4)$$

This equation was used to compare the data from a large number of different gear drives by solving for K and then determining the amount of the maximum specific stress. Needless to say, the results were far from uniform. This is to be expected, because all gear drives are not loaded to their extreme capacity. One pertinent fact, however, seemed to stand out. When the stresses thus determined were below the elastic limit of the material, the wear on most of these gears was not appreciable; when the stresses exceeded the elastic limit, in some cases the gears stood up, but some of them showed signs of rapid wear. It would appear, therefore, that the elastic limit of the material was a good stopping point in determining safe loads for wear.

It might seem that the rate of wear should be proportional to the pressures, all other factors being equal; this does not prove true in practice, however. There is evidently a critical point below which the wear is negligible and above which wear is rapid. Professor Ham remarks in his paper: "Surface pressure is the most important of the factors which affect durability. Apparently for any pair of gears there is a critical surface pressure, governed by the properties of the materials, above which the life of gears is short and below which the gears will run indefinitely without appreciable wear."

As a result of the comparisons made on different gear drives, the writer worked up a set of constants for use in establishing the maximum safe load for wear on gears of different materials. In general, these are based on maximum specific stresses of about 75 per cent of the elastic limit of the weaker material. Most of the data on cast steel was very erratic, and no attempt was made to include any of the alloy cast steels, since little information was available about the physical characteristics of this material.

In extreme cases, the writer has used values 50 per cent greater than the tabulated ones. He has data on successful drives which employ values that are double the tabulated ones, but these are exceptions, such as aëroplane drives. In that case one is justified in taking

chances on rapid wear in order to secure lighter weights, since extreme care is exercised in the production and mounting of the gears.

In order to simplify the equation still further, a pressure angle of 14½ deg. was assumed as a constant angle. This assumption reduces the loads slightly for higher pressure angles, but since the normal tooth pressures increase very slightly with higher pressure angles, the resulting difference is slight and on the side of safety. Equation (4) for wear thus reduces to the following:

$$W = DFKQ$$

where W = safe load on teeth for wear, in pounds
D = pitch diameter of pinion, in inches
F = face of gears, in inches
K = wear load factor
Q = ratio factor
n = number of teeth in pinion
N = number of teeth in gear

$$Q = \frac{2N}{N+n} \text{ for spur gears}$$

$$Q = \frac{2N}{N-n} \text{ for internal gears}$$

$$K = \frac{S^2 \sin 14\tfrac{1}{2}^\circ}{0.35}\left(\frac{1}{E_1}+\frac{1}{E_2}\right)$$

It should be noted that this last value of K is different from the first one, as it is multiplied by the sine of 14½ degrees.

The value of E, modulus of elasticity, was taken as 30,000,000 lb. per sq.in. for steel, 15,000,000 for bronze and 15,000,000 for the so-called semi-steel, which is generally used in gears. The accompanying table gives the static values of K selected for the different combinations, the maximum specific compressive stresses resulting from this selected value, and the assumed elastic limits of the materials.

The bronze referred to in the table should be a high quality of bronze. The requirements of spur gears and worm gears are quite different, so that the bronze that proves best for worm wheels is not necessarily the best for spur gears.

In Table II is summarized the foregoing equations and the values for K at different velocities that seem to work out in practice. These values are based on uniform load conditions. Intermittent and shock loads must be handled individually. With such loads, the attempt should be made to determine an equivalent steady load and to find the corresponding factors.

One other factor should be mentioned, and that is the relation between the diameter and the face of the gear. Sometimes a face of not greater than twice the diameter of the pinion is specified as the maximum face. In general, it would be better to reduce this face to not more than 1½ times the diameter of the pinion. With long faces, the torsional deflection of the pinion causes the load to be concentrated on one end, thus causing local wear. The same effect occurs if the mating gear teeth are not absolutely parallel.

We will illustrate the use of these tables by a definite example. We will take a pair of 2-d.p. gears, 20 and 60 teeth, with a 6-in. face, running at a pitch line velocity of 380 ft. per minute, and calculate from the foregoing tables their safe load for wear. These gears are made of heat-treated steel. Thus we have

$D = 10$ in.
$F = 6$ in.
Ratio $= 3/1$, whence $Q = 1.50$
K (from table) $= 104$
$W = DFKQ = 10 \times 6 \times 104 \times 1.5 = 9{,}360$ lb.

$$HP = \frac{W \times V}{33{,}000} = 108 \text{ hp.}$$

As a matter of fact, these gears are in successful operation delivering a maximum horsepower of 175, or about 62 per cent greater than that obtained from the tables. These gears are used where minimum space is essential, and also where the full power is not constantly applied. As stated before, the tabulated values are safe values for general use, and would be exceeded in extreme cases. In general, 50 per cent greater than the tabulated values is a good place to stop, as this limit seems to bring the pressures very close to the critical one where rapid wear seems to start.

We will now check over briefly the pressures used in the three series of previously mentioned experiments on the wear of gear teeth. We will start with Mr. Ross' paper. We have in the first example, 6–8 pitch, 20-deg., hardened steel gears with ⅝ in. face. There are two pairs, the first of 15 and 27 teeth, and the second of 22 and 20 teeth. The 15-tooth pinion ran at 1,500 r.p.m. and a load of 50 hp. was transmitted. This was an overload so as to obtain measurable wear in about a six-hour run. Thus, for the first pair we have

$D = 2.500$ in.
$F = 0.563$ in.

$$\text{Ratio} = \frac{27}{15}, \text{ whence } Q = 1.286$$

$$W = \frac{50 \times 33{,}000}{982} = 1{,}680 \text{ lb.}$$

Transposing our formula to solve for K, we have

$$K = \frac{W}{DFQ} = 928$$

Table I—Resulting Specific Compressive Stresses with Static Stress Factors

Material	Static K $K = \frac{S^2}{0.35}\left(\frac{1}{E_1}+\frac{1}{E_2}\right)$	Max. Specific Compressive Stress Lb. per in.²	Assumed Elastic Limit in Compression Lb. per in.²
Cast steel and cast steel	25	45,000	60,000
Forged steel and cast steel	30	50,000	80,000 and 60,000
Forged steel and forged steel	40	58,000	80,000
Hardened steel and cast steel*	50	65,000	180,000 and 60,000
Forged steel and semi-steel	60	55,000	80,000 and 80,000
Hardened steel and bronze*	70	62,000	180,000 and 54,000
Hardened steel and semi-steel	80	65,000	180,000 and 80,000
Semi-steel and semi-steel	100	58,000	80,000
Heat-treated steel and heat-treated steel	100	92,000	100,000
Hardened steel and heat-treated steel*	150	115,000	180,000 and 100,000
Hardened steel and hardened steel	250	145,000	180,000

* Experience indicates that the action of a smooth hardened tooth with one of softer material burnishes and hardens the surface of the softer material, thus enabling it to carry heavier loads without wear.

The smoothness of surface plays a very important part in minimizing wear. These tables are based on smooth cut or ground tooth surfaces with proper lubrication.

The corresponding value of K in the tables at a pitch line velocity of 982 ft. per min. is 147. This test value is over six times the tabulated value.

We will now glance at the paper of Professor Ham. The pinions used in this test were of forged steel and the gears were of cast iron or semi-steel. These were 4-d.p. gears, 18 and 72 teeth, pitch line velocity about 750 ft. per min., tooth load 1,000 lb., 1-in. width of face on test gears and 2 in. on master gears. Taking the test gears we have:

$$D = 4.500 \text{ in.}$$
$$F = 1.000 \text{ in.}$$
$$\text{Ratio} = 4/1, \text{ whence } Q = 1.60$$
$$W = 1{,}000 \text{ lb.}$$

Whence,

$$K = \frac{W}{DFQ} = 139$$

The corresponding value of K in the table for forged steel and semi-steel at 800 ft. per min. is 37. This test value is about four times the tabulated value.

On the master gears, however, with the same load but with double the face, the value of K becomes one-half of the foregoing, or about 70. Professor Ham remarks in his paper that this load on the master gears is evidently very near the critical load, beyond which rapid wear would take place. This value of K is about double the tabulated value and checks with values which have been used in practice in extreme cases.

We will next glance at Professor Marx's paper and determine the value of K used in his tests. These gears were of cast iron, or semi-steel, of 4 d.p., 1½-in. face, with 30 and 60 teeth. The pitch line velocities were 847 ft. per min. and 1,270 ft. per min. The tooth loads varied from 1,280 lb. per in. of face to 2,000 lb. per in. of face, giving K values for the higher speed of from 140 to 200. The tabulated value of K for this speed would be about 56. These test loads were from about three to four times as much as the tabulated load.

A few preliminaray runs were made to establish the loads for the tests and these gave some very valuable information. The first run employed a tooth load of 523 lb. per in. of face at a speed of 847 ft. per min. After about 20 hours running, these gears showed no measurable signs of wear. For this run we have

$$D = 7.500 \text{ in.}$$
$$F = 1.000 \text{ in.}$$
$$\text{Ratio} = \frac{60}{30}, \text{ whence } Q = 1.333$$
$$W = 523 \text{ lb.}$$

Whence $$K = \frac{W}{DFQ} = 52$$

This value of K is slightly below the tabulated value of 62 for 800 ft. per minute.

A second run was made at the same speed, but with the load increased to 1,075 lb. per in. of face. After running about 45 hours, these gears "showed visible but scarcely measurable wear, heaviest on the 30-T., 14½-deg. involute pinion, but averaging less than 0.001 in. even there." This load was evidently very close to the critical load. From this data we get $K = 108$, or about 80 per cent greater than the tabulated value of K.

Table II—Values of Ratio and Stress Factors

Ratio Factors

Ratio	1—1	2—1	3—1	4—1	5—1	6—1	7—1	8—1	9—1	10—1	12—1	15—1	Rack
Q	1.000	1.333	1.500	1.600	1.667	1.714	1.750	1.778	1.800	1.818	1.846	1.875	2.000

Stress Factors

Material in Pinion	Material in Gear	Pitch Line Velocity in Ft. per Min. 0	200	400	600	800	1,000	1,500	2,000	2,500
		Values for K								
Cast steel	Cast steel	25	19	17	16	15	14	13	12	
Forged steel	Cast steel	30	23	21	19	18	17	16	15	14
Forged steel	Forged steel	40	30	28	26	25	24	22	20	19
Hardened steel	Cast steel	50	38	35	32	31	29	27	25	24
Forged steel	Semi-steel (C.I.)	60	46	42	39	37	35	32	30	28
Hardened steel	Bronze	70	53	49	45	43	41	38	35	33
Hardened steel	Semi-steel	80	61	55	52	49	47	43	40	38
Semi-steel	Semi-steel	100	76	69	65	62	59	54	50	47
Ht.-tr. steel	Ht.-tr. steel	100	76	69	65	62	59	54	50	47
Hardened steel	Ht.-tr. steel	150	114	104	97	92	88	81	75	71
Hardened steel	Hardened steel	250	190	173	162	154	147	135	126	119

Material in Pinion	Material in Gear	Pitch Line Velocity in Ft. per Min. 3,000	3,500	4,000	5,000	6,000	7,000	8,000	9,000	10,000
		Values for K								
Hardened steel	Cast steel	23	22	21						
Hardened steel	Bronze	32	30	29	27	26	25			
Hardened steel	Semi-steel	36	34	33	31					
Ht.-tr. steel	Ht.-tr. steel	45	43	42	39	37	35	33	32	31
Hardened steel	Ht.-tr. steel	68	65	63	59	55	53	50	48	47
Hardened steel	Hardened steel	113	108	104	98	92	88	84	81	79

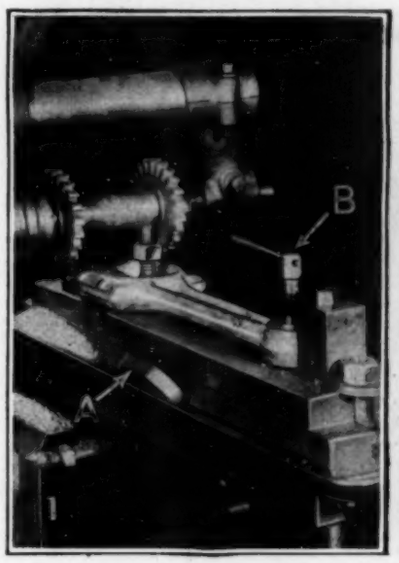
These values are for gears with smooth tooth surfaces, suitably lubricated, and carrying uniform loads. Critical pressures, beyond which rapid wear occurs, are from 50 to 100 per cent greater than tabulated values.

Automotive Production

Connecting Rods in the Stutz Shop

By Fred H. Colvin
Editor, *American Machinist*

Main features in locating and machining forged Duralumin connecting rods — Method of locating — Fixture for elongating holes—Cutting off the caps—Testing alignment



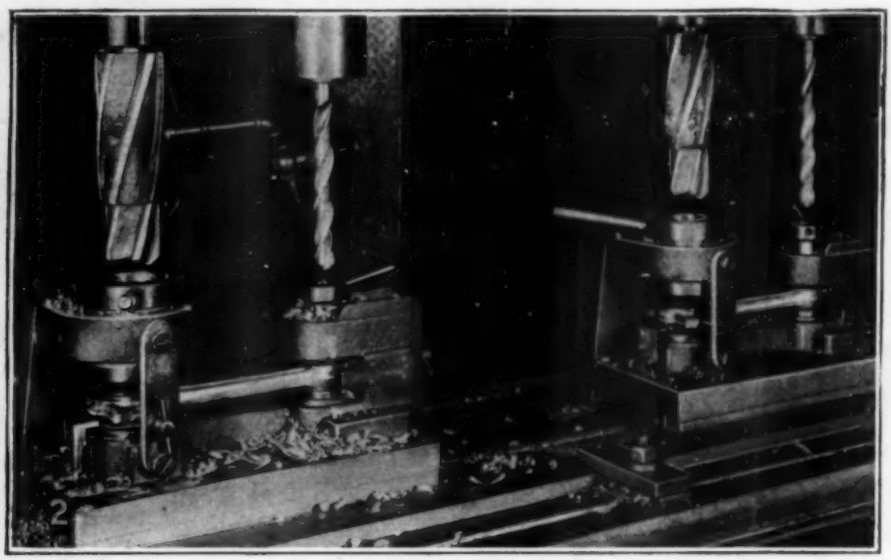


Fig. 1—Milling first location points. *Fig. 2—Rough boring both ends of rod*

THE Stutz method of handling connecting rods is a little different than that usually employed. This difference is largely in the method of securing the first locating points and is shown in Fig. 1. The rods are of Duralumin, forged and coined. The first operation is done on a Whitney hand milling machine using a pair of straddle milling cutters. The rough rod is centered from the inside of the large bore and is held at that end by the strap *A*, which has been removed to show the rod better. The piston end is clamped by the screw *B* that goes into the depression left by the forging die. The table of the machine is raised until the cutters have milled two surfaces at the ends of the bolt bosses, and is then lowered to receive the next rod. The milling at this point is done merely to give locating surfaces for future operations. The time is 0.69 minute.

Both ends of the rod are then rough drilled and bored in the 4-spindle machine in Fig. 2, in 1.10 min. The small end is centered in a V-block. Both ends are held by screw bushings that are provided with levers for easy handling. The boring tool for the large end is made with two diameters that divide the cut between them. The oil hole is drilled and chamfered, and the piston-pin hole reamed in 2.88 min. for both operations.

The hole in the large end of the rod is then elongated to allow for the amount removed in cutting the cap from the rod. This is done in the fixture shown in Fig. 3 and in detail in Fig. 4. A double-ended cutter is used in a large bar that is guided in the bushing above, to take the thrust of the one-sided cutting. The rod is located by a stud in the small hole and clamped by the flat spots milled in the first operation. A clamp at the end holds the rod down in position. The elongation is secured by the bushing *A* being made eccentric so that turning it a half revolution moves the fixture and rod, into the new position for boring. In this way half of the elongation is cut from the rod and half from the cap. The time is 1.57 minutes.

The rods are then babbitted by the centrifugal method and are ready for boring and drilling. The bolt holes are drilled in two rods at the same time. At the index-

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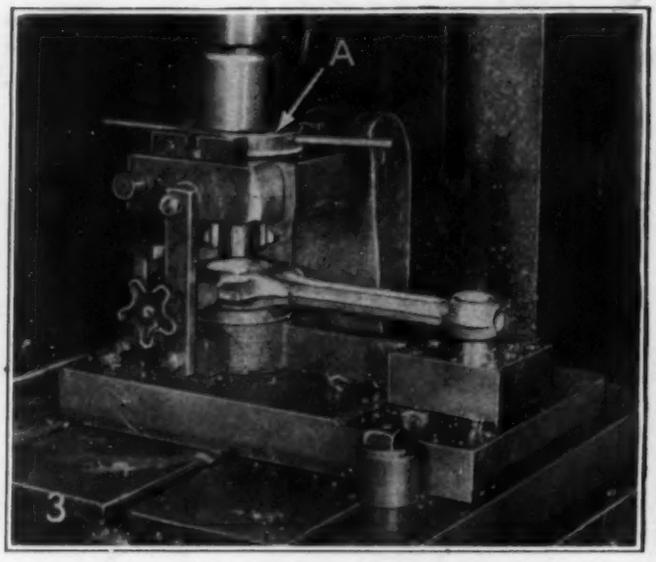


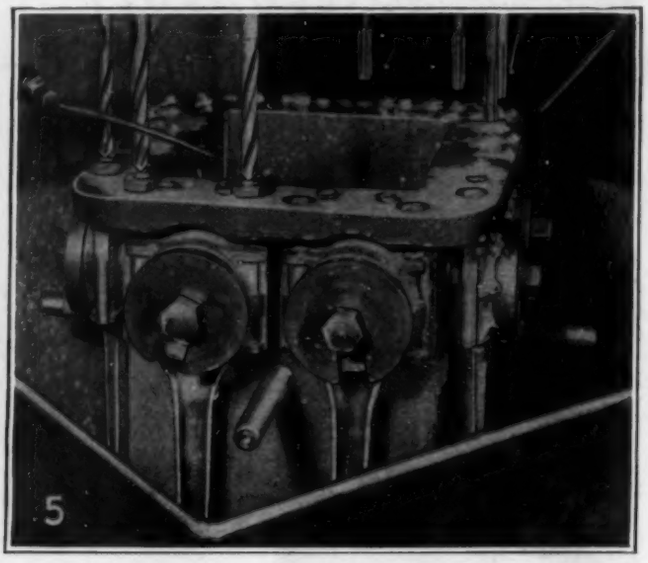


Fig. 3—Elongating the large hole. Fig. 5—Drilling and reaming both holes

ing of the fixture, Fig. 5, these same rods pass to the reaming stations and two other rods are brought under the drills. Thus, after the first indexing, two rods are drilled and two are reamed at each movement of the drilling head, in 2.25 min. The spindles are arranged so as to drill at the corners of the fixture, slip bushings being used for drilling, and are removed for reaming.

A Potter & Johnston manufacturing milling-machine is used for cutting off the caps and, at the same time, facing both ends of the bolt bosses, Fig. 6. Six rods are held in each fixture as shown, a mandrel in each end holding them in alignment and allowing easy clamping. In the first operation a slot is cut through the bolt bosses on one side of the rods, into the holes in the large ends, and at the same time both ends of the bolt bosses on that side are milled. The second operation after the rods have been placed in the next fixture with their other sides up, the procedure is repeated, and the cutting of the slot severs the caps from the rods. The mandrels test alignment and center distance. The time is 2.68 min. Joint faces are disk ground, the rod assembled and the babbitt bored to size. The time for

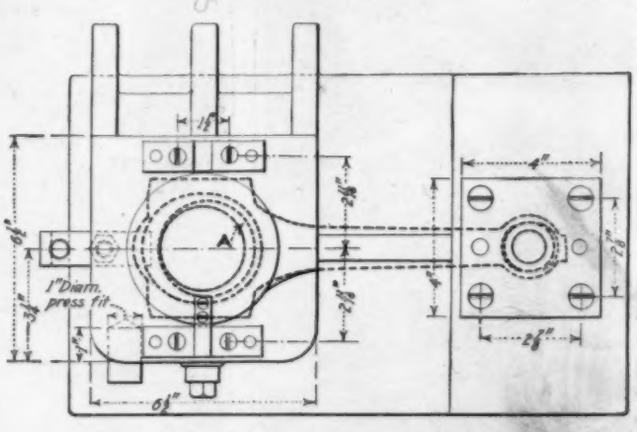
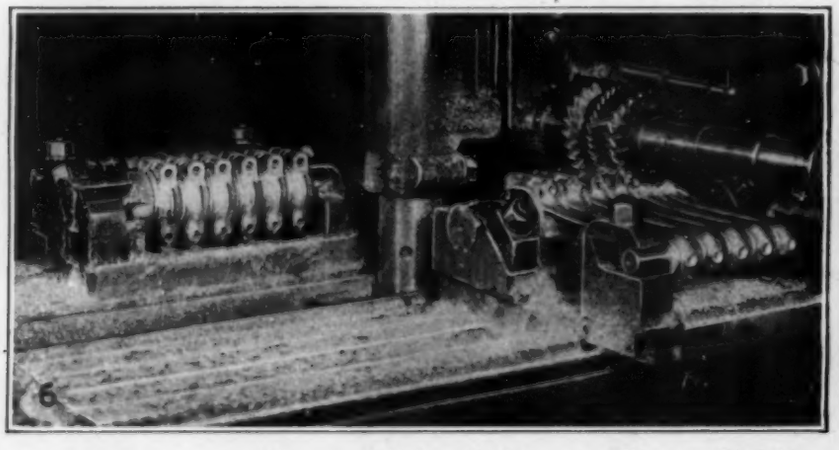


Fig. 4—Details of elongating fixture

boring is 1.01 min. The final reaming of the small hole is done in the fixture shown in Fig. 7. The large end is located over a plug, and a screw bushing holds the small end in place. The reaming time is 1.08 minutes.

The final test for alignment is given as in Fig. 8,



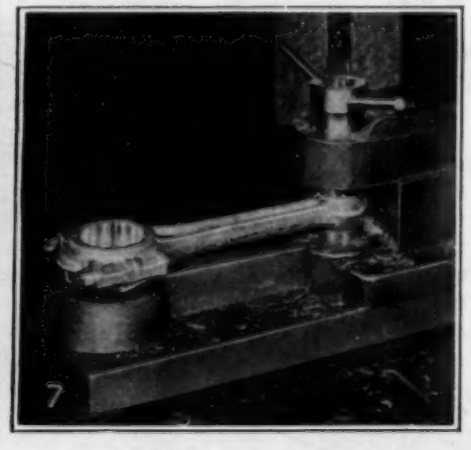


Fig. 6—Cutting off the caps. Fig. 7—Finishing reaming small hole

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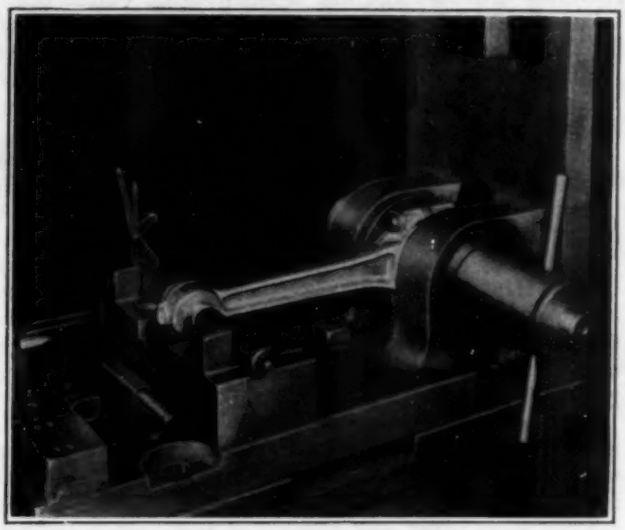


Fig. 8—Test fixture for alignment

although not all of the vertical number of the fixture is shown. The fixture is massive, to avoid spring, and the rod is tested for squareness in the usual manner. A feeler gage tells the amount of variation between the two sides, and the vertical arm of the angle acts in a similar way at right angles to the other test. In general, the Duralumin rods can be machined at about double the speed of steel rods.

Abstracts

from other publications

Press Tendencies

Dollar for dollar, as much of the metal going into this year's automobiles has been press-worked as has been machined. The proportion is increasing due to the rise of the all-steel body. There has been considerable attention devoted to swaging or coining operations in finishing such parts as the bosses of forged levers and connecting rods. Microscopic investigations show no appreciable effect upon the metal due to the squeeze. There is a very considerable saving over the milling.

More recent is the tendency toward the development of press forging and of hot sizing methods for automobile parts in copper, brass and steel. The tendency toward larger and heavier equipment still continues despite some trend toward smaller models in cars. Its cause is an increasing use of presses on the heavier gages and for parts of considerable mass.

The desire has manifested itself to combine automatically, large presses for the production of such parts as are required in sufficient quantity to keep an equipment going the year around. However, it takes careful planning, time and money to get such an equipment in order.

There is an increasing tendency to standardize on a few sizes and types of presses each capable of taking in a considerable range of work. Dies then are built to be interchangeable for a large number of machines, and the possibility of local congestion or of embarrassment in case of accident is practically eliminated. E. V. Crane of the E. W. Bliss Co., in *Automotive Industries*, March 4, p. 410.

Airplane Maintenance

The efficient maintenance of planes and motors involves a considerable amount of detail work by thoroughly trained mechanics, with very careful supervision and inspection. Planes and pilots are changed about every 400 miles. When a plane arrives at the end of its run it is received by a crew composed of a crew chief, a rigger, an expert motor mechanic and helper. First they all assist in transferring the cargo to the departing plane, then the motor mechanic proceeds to check the essential details of the power plant and its functioning. The rigger at the same time is checking vital details of the plane; the helper services the ship with fuel, oil and water, the amounts being carefully checked. The plane is then checked and rechecked by the mechanic and inspector and must be O.K.'d by the chief mechanic before being turned over to the pilot.

Air mail records for the past year indicate that mechanical difficulties which caused forced landings occur at an average of once during every 400 hours of flying. Thirty per cent of these mechanical difficulties are with the cooling system, 29 per cent with ignition; 11 per cent with carburetion, 8 per cent with lubrication and the balance with miscellaneous troubles. Air mail planes average about 800 hours fiying before major overhaul and rebuilding. This includes planes damaged in accidents. J. E. Whitbeck in *Aero Digest*, April, 1926, p. 185.

Conveyorized Production

The phrase "keep moving" has become a very important thought in this strenuous age. Material cannot with profit, loiter in going through a plant. The type of conveyor which answers the problem of "keep moving" might be termed as a main artery conveyor, Mechanical difficulties are gradually beginning to be overcome, and timing of operations in manufacture are making it possible to set up routes and traffic regulations within a plant, so that the mechanical main artery is an accomplished fact.

The entire product of a foundry can be transported on one conveyor system to the various machining departments where each article is finished and transferred back to the main artery conveyor which carried them there, and wind up at their ultimate destination, that of the point where they are to be assembled into the finished product ready for shipment.

The cost of such conveyors per foot is very low and they can be unlimited in length. There are many conveyors operating that are over a half a mile long and there is one conveyor over a mile long that has been operating for many years in a large automobile plant. Jervis B. Webb in *Industrial Management*, April, 1926, p. 230.

Reducing Costs of Cutters and Cutter Grinding

By Donald A. Hampson

THE cost of cutter-grinding is a non-productive item, in one way, yet in another way it is highly productive, because properly-ground cutters result in better work, less spoilage, and vastly increased production. It is poor economy to run cutters too long without grinding, but it is often done because of the cost of sharpening them, and of the difficulties of setting up an accurate job again.

In shops that do a great deal of milling, it is often possible to effect notable savings in cutter grinding costs, and in the costs of cutters themselves, by a careful survey of the work to be done.

First in importance, is the selection of cutters and cutter blades that will give maximum life. The added cost of superior cutting material may be wiped out in the first month by the increased life between grinds. An instance of this sort was the substitution of Stellite cutters by which 79,000 linear inches of steel were milled, as against 42,000 inches by the best of high-speed steel cutters. Such a sweeping saving is not always possible, as witnessed by another job in the same shop, where carbon-steel cutters were found to be more economical (because of their strength) on a cut where a rather delicate contour was required, along with ample tooth clearance, but it indicates what may be done toward securing long life.

Duplicate cutters are an advantage in maintaining production. With them, the only interruption in schedules is the time spent in changing cutters. While this practice is general in large manufacturing shops, it is the exception in smaller ones. Since time is worth as much in the small shop as in the large one, continuity of production in the small shop should warrant the purchase of duplicate cutters for every long-run job.

Assures Lower Costs

The use of cutters of a single style or make, is a factor in lowered costs. To have a heterogeneous collection of cutters about is an annoyance to everyone concerned, especially to the cutter-grinding crew. This, of course, does not apply to standard cataloged cutters, but it does apply to cutters of the inserted-blade type, where each one differs from the others in tooth spacing, cutting angles and method of fastening the blades in place. The one economical way to handle such cutters is to standardize on a certain design, and then to fit up the cutter grinder's bench with real equipment for quickly changing and resetting this one style of blade.

As an extreme case of standardizing on one cutter, the writer knows of a plant where the same type of cutter has been used for twenty years, resisting successfully all efforts of rival salesmen to dislodge it. Some twenty-six spindles are fitted with them. The men make their own changes and do their own resetting, rarely taking over ten minutes to the job—and for work that must be closely gaged, too. Confronted with the shop's costs for changing, and sharpening, and with its production rates, no cutter salesman has yet signed his firm's name to a guarantee of betterment.

And yet the following of precedent or of conventional methods may not be an economy. Many shops use side-milling cutters for channeling, and they do appear to be better than plain cutters that push the chips out ahead.

Side-milling cutters are the most expensive to sharpen of all types, though where a certain width of cut has to be maintained, they must have all the wear ground from the tops of the teeth, just as with plain cutters. Considering that a side-milling cutter costs about twenty-five per cent more than a plain cutter of the same size, and that it costs fully double to sharpen it properly each time, it is well worth while to go over the plant's tooling and substitute plain cutters for the more expensive type.

Interlocking, side-milling cutters are extensively used for slots that must be maintained to a certain width, but it has been the experience of close students that such cutters can be discarded in favor of the plain cutters in many cases. Usually the width of the slots may vary a total of two or three thousandths—and this is about as close as can be cut under average shop conditions of arbor and collars, and setting up. Now, any cutter will cut within such limits and so the one talking point of the interlocking cutter is lost.

For example, one concern mills $\frac{3}{4}$-in. slots in thousands of pieces weekly. Formerly, interlocking cutters were used under the impression that they were necessary to maintain the standard width of the slot, as the cutters wore. The castings milled were never any too easy on cutters, and so the sharpening of the side teeth reduced the cutter width so fast that the cutters had to be collared out about twice a week.

A Working Comparison

The department happened to come under different management that scrutinized operating costs more intelligently, to the end that plain milling-cutters were substituted for the interlocking ones. Now, the shop buys plain, 4x$\frac{3}{4}$-in. cutters and wears them down to 3$\frac{1}{2}$ in. before discarding. In that period, they cut but 10 per cent less than the interlocking cutters, before they get ground down to the discarding point (which happens to be from wear of the sides, before the face). The width of slot cut does not vary, during the life of the plain mills, any more than the other cuts. While the plain cutters cost $4.70 each as against $18.90 per pair for the interlocking ones, the sharpening time is only one-fourth and the resetting time is less.

Through such methods as outlined, many shops can effect worth-while savings in cutters and attendant costs. Tool engineers can work to no better advantage than striving to simplify cutter grinding, and this necessarily begins with the selection of cutters. One of the nationally known plants has stuck to a certain type of inserted-blade cutters for two decades or more, chiefly because they are simple to sharpen—they are of a type now largely superseded, but this plant gets ultra-modern production out of them by adopting better material for the blades, just as soon as any such material is offered, three such changes having been made to date.

In another plant, the sharpening time of milling cutters has been cut to 580 hr. per annum, by simplifying cutter shapes and specializing on a few basic forms. Cutter grinding is a production job, done by non-automatic machines, and so the way to reduce costs is to standardize and simplify cutter shapes.

The standard tools that have been designed and built for turret lathes make it possible to set up for a great variety of work in a very short time. It pays to know what standard tools are available.

The Factory Manager Speaks on Production Control and Safety

An Interview Article

By W. E. Irish
Associate Editor, *American Machinist*

Correcting speeds and feeds—Changing the price on piece work—Group payment for progressive piece-work assembly—Safety on a business basis as a dividend producer

OUR production set-up and our methods of control and procedure have been outlined. I have told you of our stand toward the ultimate responsibility of our foremen in actually producing results in their departments and of our belief in the value of a fair break between management, foremen and operators. Here are some actual happenings by way of illustration:

A piece rate had been set on a milling operation. The operator tried to make the grade on the set-up given him to work with, and finding he had trouble, complained to his foreman. Instead of finding fault, a careful investigation was made of the set-up. It was found that the work was being attempted with an 18-tooth carbon-steel milling cutter which had been set to feed at 0.00001 in. of feed per tooth and 135 ft. per minute of speed. The feed was increased to 0.001 plus per tooth and the speed was reduced to 35 ft. per minute. The operator was then asked to try again, found himself able to better his set point and was satisfied with the job.

There are certain basic principles on which piece-work rates should be set. Fault should not be found with an operator for complaining until a careful investigation is made. In any group of piece workers individual temperaments should be equally balanced. There must be an incentive for mutual assistance within groups. Responsibility in the final result must rest with the production foreman

Six men performed an assembly operation that paid a certain price for completed assemblies. A better method of assembly was found and a new rate set at a little more than two-thirds of the old figure. The men tried the new way and concluded after a short period that it could not be done. One of these six men was a natural leader. He gathered the others together, visited me and refused the job.

I felt the point had been set fairly and asked the men, through their leader, to return to the work and give it a fair chance for one more day. I guaranteed that if they could not make out on the new rate, I would pay the old one for all they had assembled. The majority were willing to try. They all went back and not only made the new rate, but bettered expectations.

A little later, I called the leader to my office and questioned him as to his past experiences. The answers I received confirmed my judgment of the man. His ambitions and capabilities were out of keeping with the work he was on. I, therefore, informed him that it would be necessary to discharge him or to give him a position in charge of men. I gave him a chance in charge of others, and he has steadily advanced to positions of increasing responsibility.

We have found that an essential to successful piece work involving the operations of a group of workers is to have all of the same average temperament. If there is one whose mind runs ahead of the work, he will soon have the others in a state entirely unsuited to the job at hand.

Combined with this policy, we keep a constant watch to discover material that can be developed to meet the requirements of the more responsible supervisory positions. Every effort is made to fill vacancies and new positions on the ladder from the ranks in the shops and the offices.

Another progressive assembly operation was performed by six girls. Each one was paid a rate for her part of the work independent of the others. Trouble was met to keep the production at even the minimum point, one or more of the girls falling behind and keeping the others back whose work depended on the previous step.

It was decided to change the individual piece-work plan and to set an overall rate for finished work from the six operations as a unit. Almost at once the production improved and in a short time was substantially above the previous best performance. Other advan-

The second of two parts; the first appeared on page 735, Vol. 64.

tages accrued from the change, as well as the increased earnings to the workers and the bettered production rate to the company.

Formerly, it was considered an average to give a new worker two weeks to get accustomed to the work, during which time the worker was paid at a day rate, and the expense of teaching was absorbed in overhead. After the change was made, this probationary period was reduced to four days, at which time it was very unusual if the new worker had not reached and bettered the minimum production figure. Formerly there were delays occasioned by one girl receiving defective work from the preceding operation. After the new plan was installed, this difficulty disappeared almost completely.

The reason for the improvement was simple and can be defined in one word—co-operation. There had previously been no incentive for one girl to help another even though the failure of one to produce affected the work as a whole. After the change-over was effected, it was brought home to all that by helping each other, the total production to which they looked for the measure of their earnings could be materially increased. Now, when a new member is started, the other five at once bend every effort to get her on a production basis. When one falls behind, the others help her to catch up.

Our policy is to set a rate for completed parts for groups of sub-operations in order to promote a mutually helpful attitude within groups.

By no means least in our established policies aimed to maintain steady and reliable production is that of safety. The methods used for the establishment of safety and the attitude taken by the executive differs from the average conception of this important subject.

Safety Work Makes Direct Profits

From a company standpoint and without reference to the resulting welfare for the worker, we regard safety as a direct means of making a profit by cutting overhead. Pursuing the subject on this basis and taking the year 1924 as a basis, when the work was started in earnest, the decrease in accidents has been 92.4 per cent. Accompanying this decrease has come a marked lessening in the insurance rates, a direct overhead item, in addition to the saving of time to production directly affecting manufacturing costs. Underlying our safety program, there are certain definite principles.

First, we believe that no worker need have an accident who pays due attention to working safely.

Second, we hold each man in charge of others directly responsible for accidents that occur.

Third, we take the stand that safety to the workers is not directly a case of physical guards and does not require the expenditure of money to install them, or other physical accident preventions, beyond those prescribed by law, but that it is directly a case of mental attitude toward the hazards of any particular operation.

Fourth, we consider any worker who allows himself to be injured, or any foreman who continues to keep a worker at an occupation toward which the worker does not take a proper safety attitude, to be a poor investment on our part.

It was necessary at the start, in order to back up this stand, to take certain steps to impress everyone that strict business was meant.

A press-shop supervisor persisted in the attitude that accidents were bound to happen, no matter how much care was taken, particularly in the press shop. This man was replaced by one who was able to hold our view.

A press operator was discharged for putting her hands between a punch and die after she had been furnished with means of placing and removing the work without so endangering herself, and after she had been warned a number of times. An inspector was released who had known of her practice when no one was thought to be looking and had contenanced it by failing to, at once, report her.

Perhaps the best way to sum up this safety work is to quote the statement of policy which I drew up at the start of the campaign. It is as follows:

A Statement of Safety Policy

The question "Does safety pay?" has been asked by a great many people concerned. As a matter of fact, safety work will pay and does pay those who make it do so, and it will pay big to industrial plants.

Safety, to pay, must have a safety organization, just the same as an industrial organization. We would not think of building automobiles or typewriters or any other product today without first building an organization of trained men. It is the same with safety work. An industrial organization must be built by the management, and he in turn must build a safety organization on his own foundation. This safety organization must consist of department heads, instructors, foremen, assistant foremen and set-up men.

The first step is to organize a safety engineering department of our people from this organization, with one safety engineer, two assistant safety engineers and one secretary, and to also organize a safety investigating board from this group. The safety department is to devise ways and means to prevent accidents; the safety investigating board is to investigate all accidents and make a written report to the management; and the safety engineering department of all major and minor accidents, explaining what caused them. The safety engineering department is to report as soon as possible what will be done to remove the hazard.

The safety engineers will inspect the plant once each week, looking for hazards. They have authority to instruct and to supervise in removing them at once if it is possible to do so, or, in other words, to stop any operations until the hazard has been removed. They will make a written report on the condition of each department, to be submitted to the management.

After this part of the safety organization has been organized, the next step is to line up the department foremen, assistant foremen, set-up men, etc., to support the heads of the present safety organization. It is found that this part of the work is not easy, as most of the people know very little above safety work. It seems that some want to know less, for it is hard work to get them out to safety meetings in order that they may educate themselves on safety. However, I want to say that whether they attend safety meetings or not, it is up to the management.

No man should be allowed to supervise operators unless he, himself, can qualify for safety work. Also, he should be dismissed from an organization until he has educated himself on safety work. There is no excuse today for any man being ignorant of this subject. There are plenty of signs, rules and laws in this state to force him to do some of this work, and every year more laws are being made. It is my opinion that in a very short time there will not be one-half of the department heads and foremen who can qualify for the

positions they are working on at present, and unless they get busy at once and educate themselves on this essential point the employer will be looking for other men who are better risks for his company.

The management has a lot to do in educating his people at present, and will have for some time to come, on this work, for he is the principal one to carry the safety work to his people and to insist that they attend all safety meetings at the plant and to know that they attend these meetings.

After the management has built up his safety organization further through the foremen, assistant foremen, set-up men, etc., he now has an organization to work directly with the operators, they in turn to work with the operators the same as the management has worked with them, to insist that operators obey safety rules and instructions and the rules of the department. They should also see that all of the operators working under them attend all of the factory safety meetings, and know that they attend these meetings 100 per cent, or give a good, reasonable excuse for non-attendance.

The foreman must educate his operators that they may know that he will not allow them to work in his department unless they comply with these rules, that they may know that this is a part of the work in this factory and that there is not any work in this factory they will be allowed to do unless they live up to these rules. In other words, this factory is a safe place to work, and they cannot have a position here unless they think and work for safety.

> No man should be allowed to supervise operators unless he, himself, can qualify for safety work. It is my opinion that in a very short time there will not be one-half of the department heads and foremen who can qualify for the positions they are working on at present, and, unless they get busy at once and educate themselves on this essential point, the employer will be looking for other men who are better risks

You will note that this safety organization is built from the management to the operators through the department heads, instructors, foremen, assistant foremen and set-up men. All should be governed alike in building this organization, and, for the benefit of all concerned, we wish to advise that safety work will be followed closer than ever before in this plant, and all those that are not with the safety organization will be checked up and dealt with accordingly. The best advice that can be given you is to study safety, talk more about safety with your people and advise that safety has only just started to do its work.

It is recognized today that it is not necessary to have major accidents and that minor accidents can be eliminated to a minimum. It is coming to the point where someone personally will be held responsible for an accident. It must be understood that all industrial plants will have to have department heads, foremen and operators, but these people will be trained on the work they are to perform, and they will get the maximum wages. There is no question but what these are facts.

What kind of a job do you want, what kind of a job will you have when these industrial rules are enforced? What would you do if an employment manager asked to see your diploma from some safety school before he would give you a position? If you could show this diploma today, you could get a good position at a good wage. We all know that the world is speeding up every day. This speeding up is bound to make hazards that will endanger lives. For this reason, our laws and rules must have more attention and the guilty ones will pay.

This statement of policy was read to every employee in our company, and it is a requirement that each new employee make himself thoroughly acquainted with the contents.

In short, the general basis for policies, in all of our activities pointing toward profitable production, is to insist upon simplicity and to set up action to control each movement that will result in forestalling errors—this, by making the job pleasant, fitting it to the worker, playing square, safeguarding the personnel by teaching the right mental attitude and by making the most of each facility with which we are provided.

We do not set a rate offhand and cut it whenever we may think an opportunity offers. We do not start any man or girl on any job on which there may be an opening at the moment. We do not assign authority to our foremen and then go over their heads to the men.

We do try to govern all of our activities in the spirit of a fair preparation before action and a strict holding to account for each individual's extent of co-operative authority on the position he or she holds.

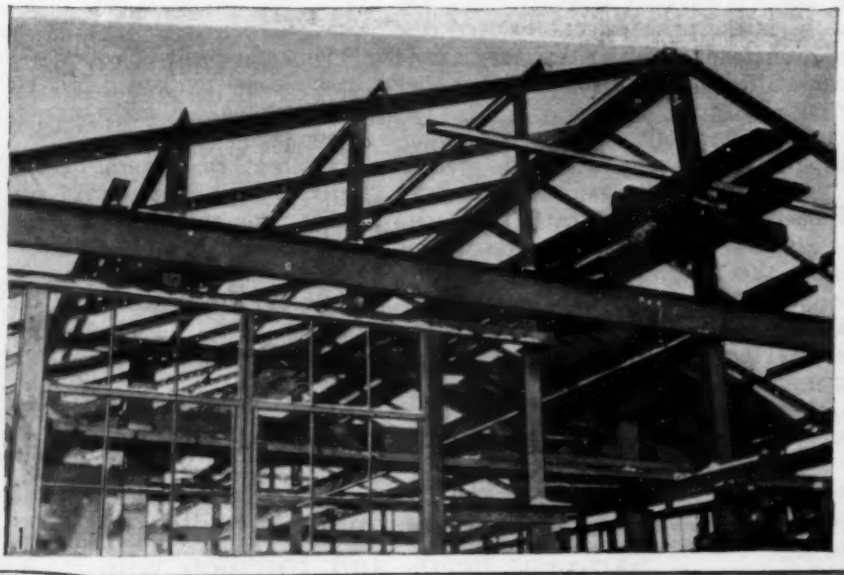
Don't think that all this is easy to accomplish. We make no point of covering the snags to good organization while we have been organizing through the past year. And we are, yet by no means perfect. That we have succeeded in making encouraging advances is attested by our records of increasing productivity, advancing economy, and decreasing trouble.

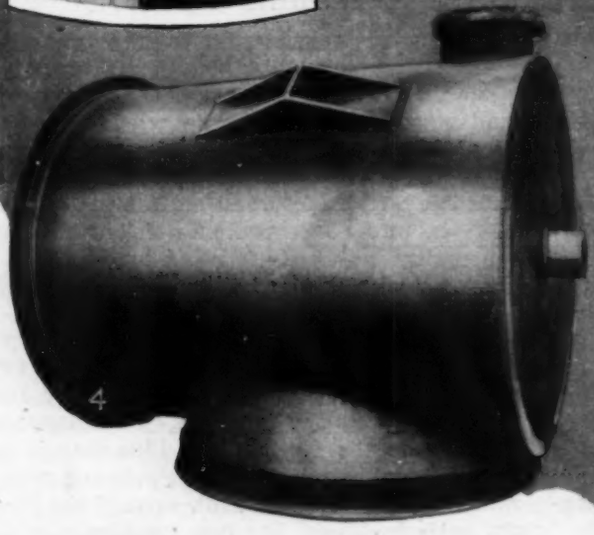
Getting in on Time

Docking an employee for lateness may be one way of enforcing punctuality, but it often leaves a bad taste in his mouth. One company that employs over a thousand persons adopted the opposite point of view and offered a reward of a dollar a week for coming in on time. The reward is paid only if the worker is punctual for three weeks in succession, a system that is necessary in order to prevent violent fluctuations of punctuality one week followed by tardiness the next. Does it work? You'd be surprised to learn how many people take advantage of these extra dollars.

Any machine that has not been "sold" to men who are to use it has a hard row to hoe, and the management that forces new machines on a department without "selling" to the foreman the idea that it is the best machine for the job, is not likely to secure the greatest returns from its investment, even if the foreman does not actively oppose the new machine.

Various Examples of





1—A building frame with welded joints made from scrap steel formerly riveted

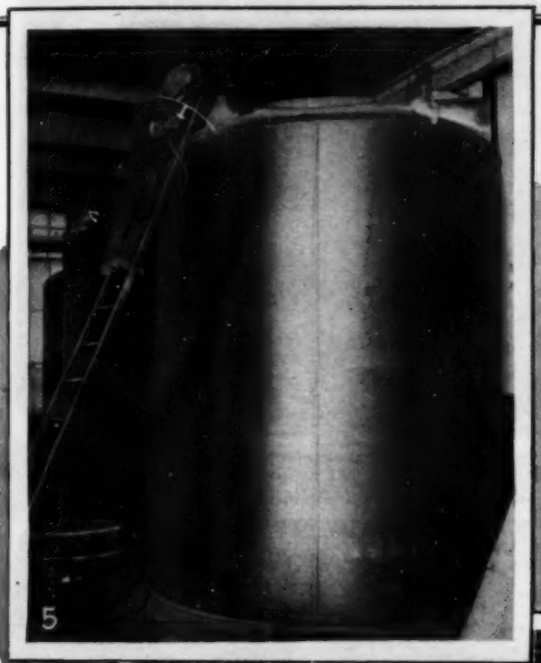
2—Crane-runway supports welded on after building was erected

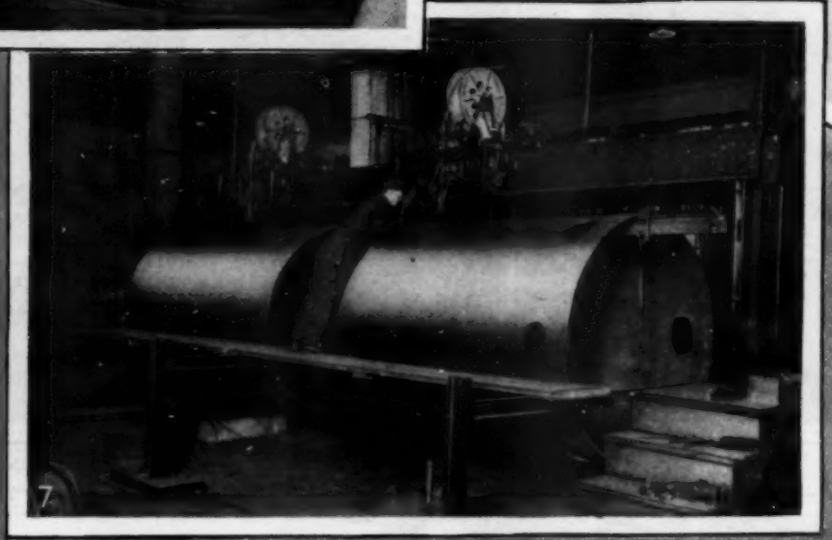
3—Large annealing car for electric oven —all joints are welded

4—Condenser shell—all seams are welded

Photographs by courte

Arc-Welded Joints





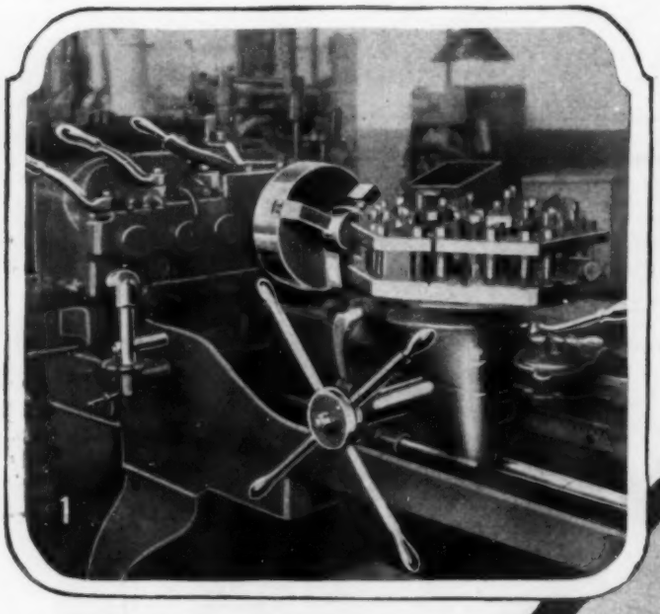
5—Welding a tank for an oil circuit-breaker

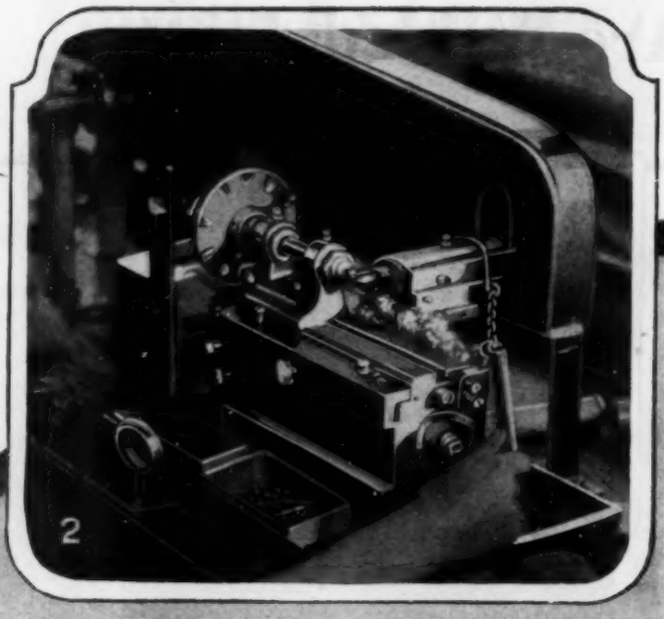
6—Strainers for steam lines—Monel-metal screen inside of steel screen

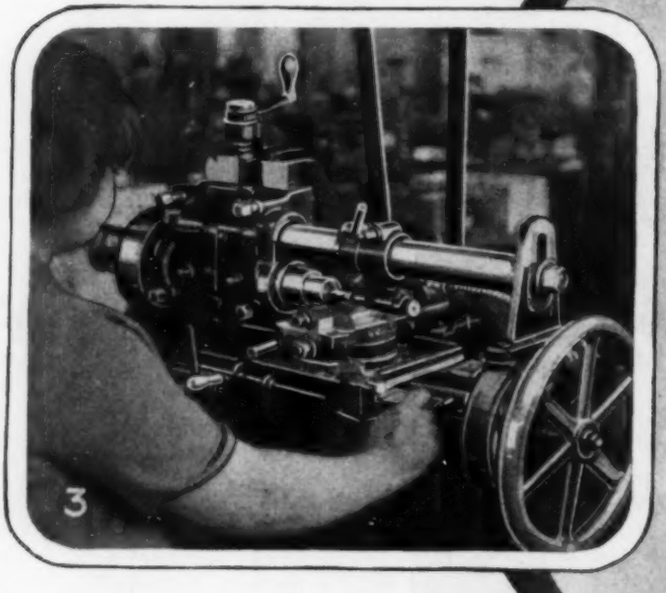
7—Automatic tank-welding machines at General Electric Co., Schenectady, N. Y.

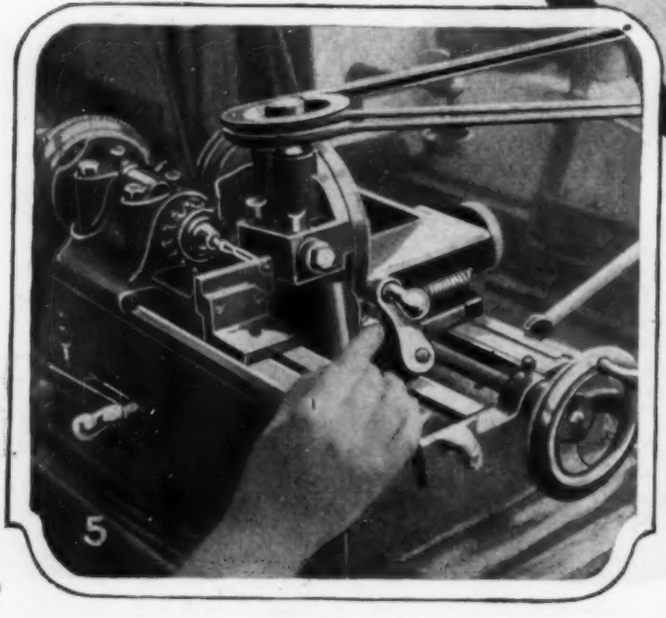
8—Arc-welded cabinet

General Electric Co.









Jobs That Count

1—Machining cases for odometers

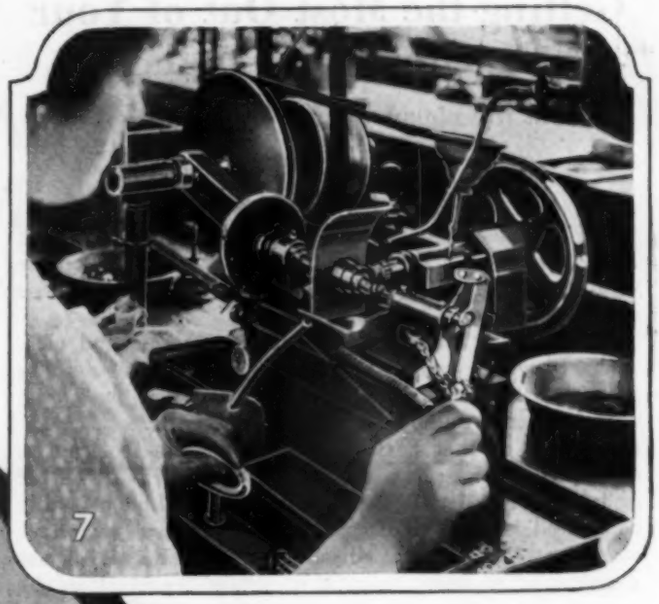
2—A small milling job

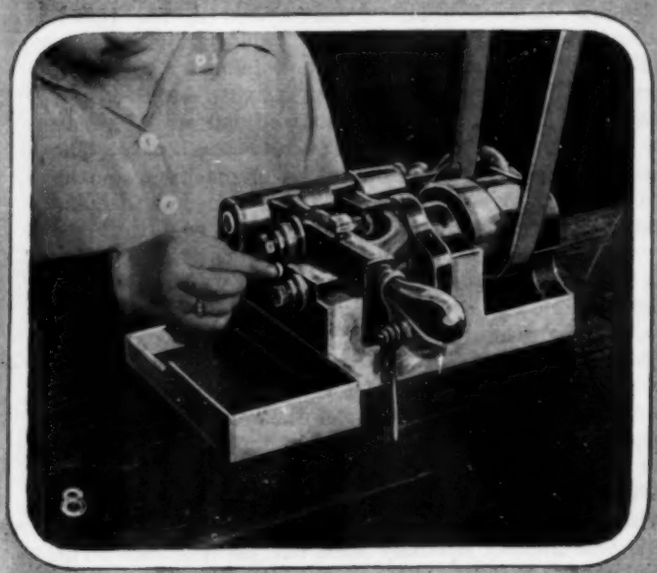
3—Cutting small worms

4—Trimming die-cast wheels

5—Milling small threads

Photographs by courtesy of





in Making Counters

6—Tapping cases for name plates

7—Milling any number of slots in counting wheels

8—Rolling threads on brass disks

9—Typewriter for stamping serial numbers

10—Tapping machine for small holes

tesy of the Veeder Manufacturing Co.

Getting the Most Out of Your Machine Tool Dollar

From the viewpoint of the machine tool industry

By W. F. Sandman

EVERY machine tool is sold as a potential dividend payer. Whether it pays dividends at the end of one year or ten years of service is governed by what type of tool it is and where it is used.

In the great production plants of Detroit and elsewhere machine tools are purchased with the definite idea that so many hours of operation will make the user a certain number of dollars in return, and at the completion of that period of operation the tool can be consigned to the scrap as if it were a worn-out cutter or twist drill. It will have done its work and probably completed its period of maximum usefulness and have started on the decline. Obsolesence in such cases is not a matter of so many years at a certain depreciation per year but a matter of so many pieces produced at a certain cost per piece. Of course, a machine tool is not scrapped always because it has finished the work it was purchased for. It may go on for years after that—or for days.

It is the machine tool manufacturer that brings about the premature obsolesence of machine tools in the production plants. For instance, the now well-known centerless grinder was brought out only a few short years ago. Within an incredibly short space of time it opened up a new viewpoint of grinding and automatically retired hundreds of the center type grinders to the discard because it would handle certain work at so great a saving per piece over the old method that it was good dollars and cents business to do away with them even though they were far from being worn out.

Recent Developments

The centerless is only one example out of dozens where the machine tool manufacturer by improving designs has shown the machine tool user how to get the most production per dollar of machine tool money expended. Lathes, gear hobbers, machines of all types have been developed within the three or four years just passed to higher points of production and accuracy than ever before thought possible.

But in other plants, thousands of them, dizzy production is not sought and the machine tool dollars are invested carefully and expected to cover a course of years. Depreciation is fixed—a certain number of years and the tool is wiped off the books. It is purchased with the idea that it will last through that period of years and earn its proportion of the profits and when its account is closed to still have some value as a used tool.

So the machine tool industry has to supply many classes of users between the two extremes and render a class of service not expected of any other line of manufacture.

It is the laudable ambition of the machine tool builder to equip as many users as possible with his particular line of tools. Although that ambition may have its selfish aspects, its attainment, if rightly reached, is entirely beneficial to the tool purchaser. The tool is an investment and if the builder of the tool sees that the purchaser cannot make it a paying investment the installation should not be made—and is not made by a reputable manufacturer.

If the purchaser will "lay his cards on the table" when he needs machine tool equipment the chances are many to one that the machine tool manufacturer and his dealer will see that the purchaser spends his dollars in such a way that they will bring in their share of the annual dividend.

Advertisements and the Product

By C. G. Williams

In looking over the advertisements of machine tools in the pages of technical magazines, I find the word "best," coupled with such terms as "least effort," "quicker," "above the rest," etc., and I sometimes wonder if the manufacturer of machinery is not "straining at a gnat and swallowing a camel" in his usage of extravagant expressions.

Several years ago, I visited the branch office of a firm making some of the really "best" tools to be found on the market. A catalog was asked for.

During the conversation that followed, the representative stated: "We have just sold your railroad a radial drill. I made the sale, and in order to put it over, we were compelled, as it were, to build a new machine. The purchasing agent did not want to pay the price of one of our heavy-duty machines. The master mechanic wanted our make of machine, and he wanted a swing of six feet. We were bound to make that sale, and as the master mechanic said that the machine would be used principally for light drilling, we took one of our high columns for a light, four-foot machine and put a six-foot arm on it. It made a good job and the master mechanic was satisfied."

At this point I said, "Excuse me, that is just where you made your greatest mistake—putting out a makeshift. If you know anything of the work in a railroad shop, you must know the abuse that tool will get. Some one will want a 3-in. hole drilled. The general foreman seeing that drill press vacant, or at work on a piece that will soon be done, will say, 'Take it there.' This will happen not only once but many times. The result will be that pulling a 3-in. drill in a machine built for 1½-in., as a maximum, will spring the daylights out of that column and the arm, so that the machine will be no longer accurate. Its life will have been pulled out of it and repairs will soon follow. Then your firm will get the black eye. No matter if you have put the best material available into the machine, it was built for light work, but of a size that suggests its fitness for the heaviest work. Because it has been abused and has been compelled to pull a load ten times as heavy as it was designed for, and has not the stamina to stand up to it, your company must reap the reward."

The makeshift never pays. Recommending a tool too light for the work it may have to do, is only another way of cutting your own throat. It is the same with machines, mules, or men. Abuse them and you have nothing of value left.

A word about waiting rooms. Prevent the waiting if possible, but when it can't be avoided, provide a place to sit comfortably; a place to hang hat and coat; something worth-while to read; and an absence of drafts and boiling radiators.

Mathematical Analysis of the Geneva Movement

By Frederick Seybold
The Seybold Machine Co., Dayton, Ohio

Problems of velocity and acceleration conveniently solved by the use of tabulated data for three-, four-, and six-slot Geneva disks

IN THE design of the Geneva stop mechanism, especially if the parts of the mechanism are massive and the power required to drive it is comparatively great, the problem that presents itself to the designer, in order that he may properly proportion its component parts, resolves itself into the determination of the variable angular velocity and the variable angular acceleration of the driven element.

From these determinations the force on the driving roller can be computed by means of the relation,

$$T = I\alpha_\phi \quad \text{and} \qquad (1)$$

$$T = Fd, \quad \text{where} \qquad (2)$$

T = torque about the axis of the Geneva disk, in ft.-lb.

I = moment of inertia of the driven element, in ft.-lb. sec^2.

α_ϕ = angular acceleration of the driven element, in radians per sec^2.

F = force on driving roller, in lb.

d = moment arm of F, in ft.

In Fig. 1 is shown the outline of a typical form of the Geneva stop at the beginning of its cycle. The Geneva movement is kinematically a special form of the four-bar linkage in which the length of three imaginary links varies during a cycle. The number of slots in the Geneva disk may vary from three to infinity theoretically. Of course, in practice the number of slots will not be very great.

In Fig. 2 the center distance between the driving and the driven element is OA, the driving arm is AB, and the driven element is OB. Co-ordinate axes XX' and YY', having their origin at O, are drawn and the angle at which the driver AB makes with the XX'-axis is designated by θ and the angle BOA of the driven element by ϕ. The total angle turned through by a 4-slot Geneva stop, for example, is 90 deg. during one cycle, but if referred to the XX'-axis the angle turned through is measured +45 deg. above and −45 deg. below the XX'-axis.

The meaning of the other symbols to be employed is explained below:

N = number of slots in the Geneva disk

a = ratio, $\dfrac{\text{center distance}}{\text{driving arm length}} = \dfrac{OA}{AB}$

ω_θ = uniform angular velocity of the driving arm AB in radians per sec.

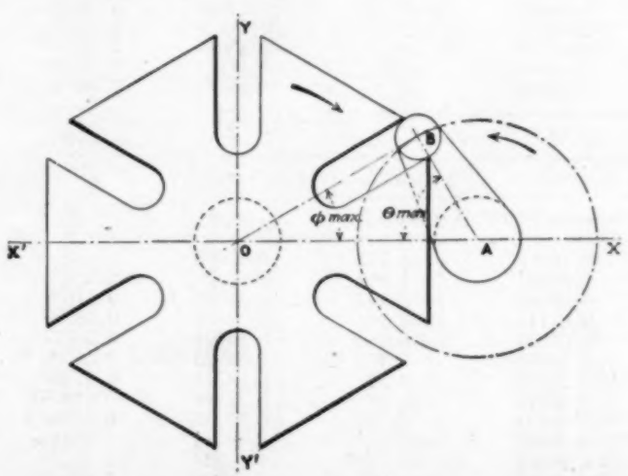
ω_ϕ = variable angular velocity of the Geneva disk in radians per sec.

α_ϕ = variable angular acceleration of the Geneva disk in radians per sec^2.

We are now ready to derive the required formulas.

$$\theta_{max.} = 90° - \phi = 90° - \frac{180°}{N} = \frac{\frac{\pi N}{2} - \pi}{N} \text{ radians} \qquad (3)$$

$$a = \frac{OA}{AB} = \frac{1}{\cos \theta_{max.}} \qquad (4)$$



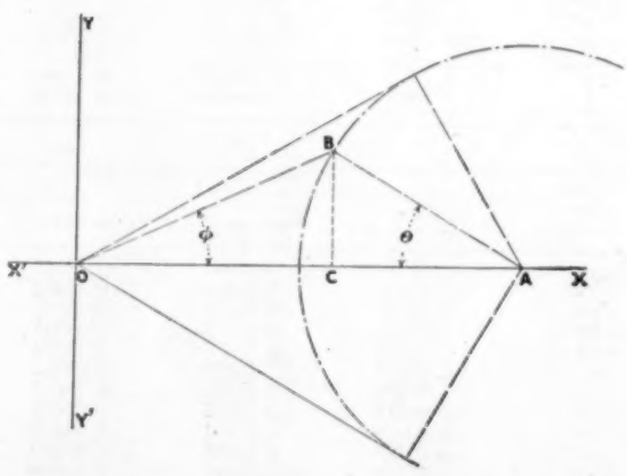


Fig. 1—Position of the disk at the beginning of the cycle. *Fig. 2—Intermediate position of the Geneva disk*

As the angle *BAO* decreases at a uniform rate due to a uniform motion of the driving arm *AB*, the angle *BOA* decreases also, but not at a uniform rate, this rate being less at first and later greater than the uniform rate of change of angle *BAO*. An inspection of Fig. 2 makes this evident.

The magnitude of ϕ for any value of θ is given by the trigonometric relation,

$$\tan\phi = \frac{BC}{OC} = \frac{AB\sin\theta}{OA - AB\cos\theta} = \frac{\sin\theta}{\frac{OA}{AB} - \cos\theta}$$

$$= \frac{\sin\theta}{a - \cos\theta}, \text{ or}$$

$$\phi = \tan^{-1}\frac{\sin\theta}{a - \cos\theta} \qquad (5)$$

It follows from the above equations that ϕ is a function of θ; i.e., there is a definite value for ϕ corresponding to a certain value of θ.

If the angular velocity of the driving arm *AB* is constant and equal to ω_θ radians per second, then the value of θ is given by the relation, if t is the time,

$$\theta = \omega_\theta t$$

As the angle ϕ does not change at a uniform rate for equal intervals of time t, the variable angular velocity ω_ϕ of the Geneva disk is equal to,

$$\omega_\phi = \frac{d\phi}{dt}$$

The rate of change of ϕ with respect to θ can be determined from equation (5) by means of calculus.

$$\frac{d\phi}{d\theta} = \frac{a\cos\theta - 1}{1 - 2a\cos\theta + a^2} \qquad (6)$$

Also $d\theta = \omega_\theta\, dt$, or $dt = \frac{d\theta}{\omega_\theta}$, whence

$$\omega_\phi = \frac{d\phi}{dt} = \frac{\omega_\theta d\phi}{d\theta} = \left(\frac{a\cos\theta - 1}{1 - 2a\cos\theta + a^2}\right)\omega_\theta \qquad (7)$$

By means of this equation the angular velocity of

Table I—Summation of Maximum Values of Velocity and Acceleration for Geneva Mechanisms

No. of Slots in Disk	$\frac{90° - 180°}{N}$ θ max.	$\frac{1}{\cos\theta_{max.}}$ a	$\frac{a\cos\theta - 1}{1 - 2a\cos\theta + a^2}$ Max. Velocity Multiply by ω_θ	$\frac{a\sin\theta(1-a^2)}{[1-2a\cos\theta+a^2]^2}$ Max. Acceleration Multiply by ω_θ^2	Position θ of Arm at Max. Acceleration Equation (9)	Position ϕ of Disk at Max. Acceleration Equation (5)	Acceleration at Entrance and Exit Multiply by ω_θ^2
3	30°	1.1547	6.46	31.42	4°55′	28°25′	1.732
4	45°	1.4142	2.42	5.41	11°31′	24°40′	1.000
5	54°	1.7013	1.43	2.29	17°34′	21°59′	0.726
6	60°	2.0000	1.00	1.35	22°54′	19°50′	0.577
7	64°17′	2.3046	0.766	0.930	27°33′	18° 4′	0.482
8	67°30′	2.6131	0.620	0.699	31°39′	16°35′	0.415

Note—To obtain velocity or acceleration, multiply factor given in table by the angular velocity of the arm in radians per sec. (squared for acceleration). One radian equals 57.3 deg. and one revolution equals 6.28 (2π) radians.

Table II—Values of the Equations for a Three-Slot Geneva Mechanism

1	2	3	4	5	6	7	8
Driving Arm θ	$\sin\theta$	$\cos\theta$	$a - \cos\theta$	$\frac{\sin\theta}{a-\cos\theta}$	Geneva Stop ϕ	$a\cos\theta - 1$	$2a\cos\theta$
30°	0.50000	0.86603	0.28867	1.73205	60°	0.00000	2.00000
27°	0.45399	0.89101	0.26369	1.7216	59°51′	0.02885	2.05769
24°	0.40674	0.91354	0.24116	1.6866	59°20′	0.05486	2.10972
21°	0.35837	0.93358	0.22112	1.6207	58°20′	0.07800	2.15600
18°	0.30902	0.95106	0.20364	1.5174	56°37′	0.09819	2.19638
15°	0.25882	0.96592	0.18878	1.3710	53°54′	0.11535	2.23069
12°	0.20791	0.97815	0.17655	1.1776	49°40′	0.12957	2.25914
9°	0.15643	0.98769	0.16701	0.93665	43° 7′	0.14048	2.28096
6°	0.10453	0.99452	0.16018	0.65257	33° 7′	0.14837	2.29674
4°55′	0.08571	0.99632	0.15838	0.54117	28°25′	0.15044	2.30090
3°	0.5234	0.99863	0.15607	0.33536	18°32′	0.15312	2.30624
0°	0.0000	1.00000	0.15470	0.00000	0°	0.15470	2.30940

1	9	10	11	12	13	14	15
Driving Arm θ	$1 - 2a\cos\theta + a^2$	$\frac{a\cos\theta - 1}{1 - 2a\cos\theta + a^2}$	$a\sin\theta(1-a^2)$	$[1-2a\cos\theta+a^2]^2$	$\frac{a\sin\theta(1-a^2)}{[1-2a\cos\theta+a^2]^2}$	$\cos\phi$	$\cos(\theta+\phi)$
30°	0.33333	0.00000	0.19245	0.11111	1.732	0.50000	0
27°	0.27574	0.10462	0.17484	0.07603	2.299	0.50226	0.05495
24°	0.22361	0.24533	0.15655	0.05000	3.131	0.51004	0.11609
21°	0.17733	0.43975	0.13793	0.03145	4.385	0.52498	0.18509
18°	0.13695	0.71697	0.11894	0.01874	6.344	0.55024	0.26527
15°	0.10264	1.12383	0.09962	0.01053	9.465	0.58920	0.36000
12°	0.07419	1.74646	0.08002	0.00550	14.55	0.64724	0.47460
9°	0.05237	2.68245	0.06021	0.00274	21.97	0.72996	0.61405
6°	0.03659	4.05493	0.04023	0.00134	30.22	0.83756	0.77586
4°55′	0.03243	4.63884	0.03299	0.00105	31.42	0.87951	0.83549
3°	0.02709	5.65227	0.02014	0.00073	27.58	0.94814	0.93020
0°	0.02393	6.46469	0.00000	0.00000	0.00	1.00000	1.00000

Table III—Values of the Equations for a Four-Slot Geneva Mechanism

1	2	3	4	5	6	7	8
Driving Arm θ	$\sin\theta$	$\cos\theta$	$a-\cos\theta$	$\frac{\sin\theta}{a-\cos\theta}$	Geneva Stop ϕ	$a\cos\theta-1$	$2a\cos\theta$
45°	0.70711	0.70711	0.70711	1.00000	45°	0.00000	2.00000
40°	0.64279	0.76604	0.64820	0.99165	44°46′	0.08335	2.16671
35°	0.57358	0.81915	0.59508	0.96387	43°57′	0.15846	2.31693
30°	0.50000	0.86603	0.54820	0.91207	42°22′	0.22477	2.44953
25°	0.42262	0.90631	0.50792	0.83203	39°46′	0.28173	2.56346
20°	0.34202	0.93969	0.47454	0.72074	35°47′	0.34894	2.65787
15°	0.25882	0.96592	0.44831	0.57735	30°	0.36603	2.73206
11°31′	0.19965	0.97987	0.43436	0.45941	24°40′	0.38576	2.77147
10°	0.17365	0.98481	0.42942	0.40438	22° 1′	0.39275	2.78549
5°	0.08715	0.99619	0.41804	0.20847	11°46′	0.40884	2.81768
0°	0.00000	1.00000	0.41423	0.00000	0°	0.41423	2.82846

1	9	10	11	12	13	14	15
Driving Arm θ	$1-2a\cos\theta+a^2$	$\frac{a\cos\theta-1}{1-2a\cos\theta+a^2}$	$a\sin\theta(1-a^2)$	$[1-2a\cos\theta+a^2]^2$	$\frac{a\sin\theta(1-a^2)}{[1-2a\cos\theta+a^2]^2}$	$\cos\phi$	$\cos(\theta+\phi)$
45°	1.00000	0.000	1.00000	1.00000	1.00	0.70711	0.00000
40°	0.83329	0.100	0.90905	0.69404	1.31	0.70998	0.09121
35°	0.68307	0.232	0.81117	0.46658	1.74	0.71994	0.19166
30°	0.55047	0.408	0.70711	0.30301	2.33	0.73885	0.30292
25°	0.43654	0.645	0.59768	0.19056	3.14	0.76865	0.42630
20°	0.34213	0.960	0.48369	0.11705	4.12	0.81123	0.56232
15°	0.26794	1.370	0.36603	0.07179	5.10	0.86603	0.70711
11°31′	0.22853	1.690	0.28235	0.05223	5.41	0.90875	0.80713
10°	0.21451	1.830	0.24568	0.04601	5.34	0.92707	0.84789
5°	0.18232	2.240	0.12325	0.03324	3.71	0.97899	0.95749
0°	0.17154	2.420	0.00000	0.02942	0.00	1.00000	1.00000

Table IV—Values of the Equations for a Six-Slot Geneva Mechanism

1	2	3	4	5	6	7	8
Driving Arm θ	$\sin\theta$	$\cos\theta$	$a-\cos\theta$	$\frac{\sin\theta}{a-\cos\theta}$	Geneva Stop ϕ	$a\cos\theta-1$	$2a\cos\theta$
60°	0.86603	0.50000	1.50000	0.57735	30°	0.00000	2.00000
55°	0.81915	0.57358	1.42642	0.57427	29°52′	0.14716	2.29432
50°	0.76604	0.64279	1.35721	0.56442	29°26′	0.28558	2.57116
45°	0.70711	0.70711	1.29289	0.54697	28°40′	0.41422	2.82844
40°	0.64279	0.76604	1.23396	0.52091	27°31′	0.53208	3.06416
35°	0.57358	0.81915	1.18085	0.48573	25°55′	0.63830	3.27660
30°	0.50000	0.86603	1.13397	0.44093	23°48′	0.73206	3.46412
25°	0.42262	0.90631	1.09369	0.38641	21° 8′	0.81262	3.62524
22°54′	0.38912	0.92118	1.07882	0.36069	19°50′	0.84236	3.68472
20°	0.34202	0.93969	1.06031	0.32256	17°53′	0.87938	3.75876
15°	0.25882	0.96592	1.03408	0.25029	14° 3′	0.93186	3.86368
10°	0.17365	0.98481	1.01519	0.17105	9°43′	0.96962	3.93924
5°	0.08715	0.99619	1.00381	0.08681	4°58′	0.99238	3.98476
0°	0.00000	1.00000	1.00000	0.00000	0°	1.00000	4.00000

1	9	10	11	12	13	14	15
Driving Arm θ	$1-2a\cos\theta+a^2$	$\frac{a\cos\theta-1}{1-2a\cos\theta+a^2}$	$a\sin\theta(1-a^2)$	$[1-2a\cos\theta+a^2]^2$	$\frac{a\sin\theta(1-a^2)}{[1-2a\cos\theta+a^2]^2}$	$\cos\phi$	$\cos(\theta+\phi)$
60°	3.00000	0.0000	5.19618	9.00000	0.5773	0.86603	0.00000
55°	2.70568	0.0543	4.91490	7.3207	0.6713	0.86719	0.08947
50°	2.42884	0.1175	4.59624	5.8993	0.7791	0.87093	0.18338
45°	2.17156	0.1907	4.24266	4.7156	0.9000	0.87742	0.28122
40°	1.93584	0.2748	3.85674	3.7473	1.029	0.88688	0.38241
35°	1.72340	0.3703	3.44148	2.9701	1.158	0.89943	0.48608
30°	1.53588	0.4766	3.00000	2.3589	1.271	0.91496	0.59060
25°	1.37476	0.5911	2.53572	1.8899	1.341	0.93274	0.69298
22°54′	1.31528	0.6404	2.33472	1.7299	1.350	0.94068	0.73452
20°	1.24124	0.7084	2.05212	1.5406	1.332	0.95168	0.78926
15°	1.13632	0.8209	1.55292	1.2912	1.202	0.97008	0.87420
10°	1.06076	0.9140	1.04190	1.1252	0.9260	0.98565	0.94137
5°	1.01524	0.9812	0.52290	1.0307	0.5073	0.99624	0.98491
0°	1.00000	1.0000	0.00000	1.0000	0.0000	1.00000	1.00000

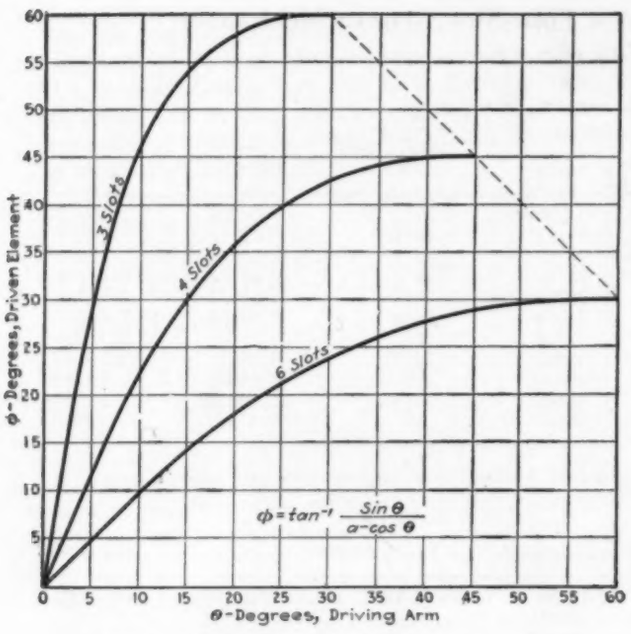


Fig. 3—Angular displacement curves

the Geneva disk can be computed accurately for any given value of θ, corresponding to a certain value of ϕ.

The angular acceleration is the rate of change of the angular velocity, or

$$\alpha_\phi = \frac{d\omega_\phi}{dt} = \frac{d^2\phi}{dt^2} = \frac{\omega_\theta^2 d^2\phi}{d\theta^2} = \frac{(a - a^3)\sin\theta\,\omega_\theta^2}{(1 - 2a\cos\theta + a^2)^3} \quad (8)$$

The angular acceleration of the Geneva disk can now be computed for any position of the driving arm *AB*.

However, we are interested most in the value and location of the maximum angular acceleration of the Geneva disk, because this will determine the maximum stress on the driving roller. Hence, when we equate the derivative of equation (8) to zero, the value of θ for maximum angular acceleration is given.

If equation (8) is differentiated in a certain manner and equated to zero, we get,

$$\cos^2\theta + \left(\frac{a^2+1}{2a}\right)\cos\theta - 2 = 0 \quad (9)$$

$$\text{Let } \frac{a^2+1}{2a} = p, \text{ then}$$

$$\cos^2\theta + p\cos\theta - 2 = 0 \quad (9a)$$

This equation is of the second degree and may be readily solved thus,

$$\cos\theta = -\frac{p}{2} + \frac{1}{2}\sqrt{p^2+8} \quad (9b)$$

For a 6-slot design, $a = 2$, $p = \frac{5}{4}$;

$$\cos\theta = -\frac{5}{8} + \frac{1}{2}\sqrt{\frac{25}{16}+8}$$
$$= -0.625 + 1.842325$$
$$= 0.92116$$
$$\theta = 22^\circ\ 54'$$

Since the angular velocity of the disk has its maximum value always when the slot and the driving arm are in line; i.e., when θ and ϕ are equal to zero, equation (7) can be simplified into

$$\omega_{\phi\,max.} = \left(\frac{1}{a-1}\right)\omega_\theta \quad (10)$$

By means of the derived formulas, the tables for 3-slot, 4-slot and 6-slot Geneva movements have been prepared and the angular displacement curves, Fig. 3, the angular velocity curves, Fig. 4, and the angular acceleration curves, Fig. 5, of the Geneva disk for unit angular velocity of the driving arm have been plotted.

To obtain the actual angular velocity of the Geneva disk in a given case, multiply the value as obtained from the table or velocity curve in Fig. 4 by the actual angular velocity of the driving arm in radians per second.

To obtain the actual angular acceleration of the Geneva disk in a certain position multiply the value as obtained from the table or the curve in Fig. 5 by the square of the actual angular velocity of the driving arm in radians per second.

We shall now apply the derived formulas to the design of a specific case. A turret table, two feet square and weight *W* of 2,400 lb., is to be indexed in quarters as shown in Fig. 6. The speed of the driving arm is 20 revolutions per minute.

The moment of inertia of a square block of side *l*, and mass *M* is given by

$$I = \frac{Ml^2}{6} \text{ ft.-lb. sec}^2.$$

$$I = \frac{4M}{6} = \frac{2W}{3g} = \frac{4{,}800}{96.6} = 49.6 \text{ ft.-lb. sec}^2.$$

$$20 \text{ r.p.m.} = \tfrac{1}{3} \text{ r.p.s.} = 2\pi/3 \text{ radians per sec.} = \omega_\theta$$

$$\omega_\theta^2 = \frac{4\pi^2}{9} = 4.39 \text{ radians per sec}^2.$$

The maximum angular acceleration of a 4-slot Geneva movement for unit angular velocity of the driving arm is 5.41 radians per second per second and may be computed by means of equations (8) and (9), or its value may be taken from the curve in Fig. 5. Hence,

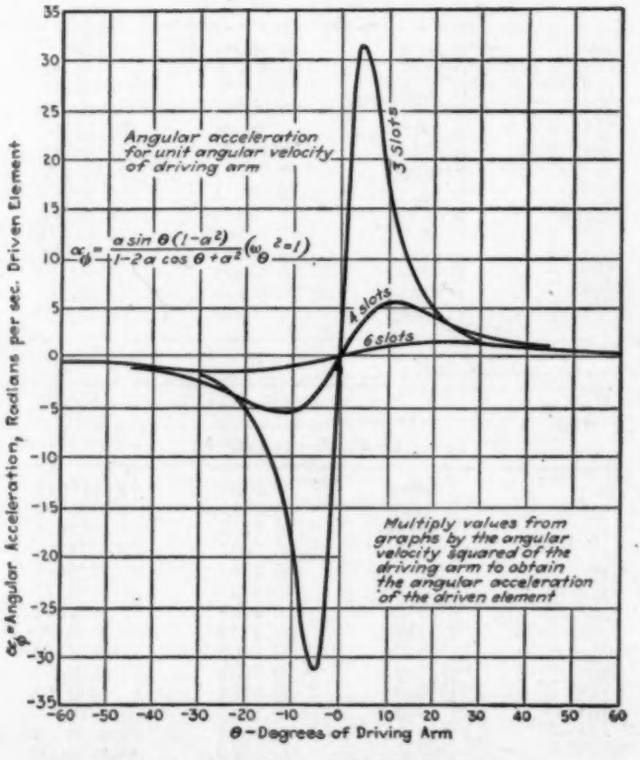

Angular acceleration for unit angular velocity of driving arm
$\alpha_\phi = \frac{a\sin\theta(1-a^2)}{1-2a\cos\theta+a^2}(\omega_\theta^2=1)$
3 Slots
4 slots
6 slots
Multiply values from graphs by the angular velocity squared of the driving arm to obtain the angular acceleration of the driven element
α_ϕ = Angular Acceleration, Radians per sec. Driven Element
θ-Degrees of Driving Arm

Fig. 5—Angular acceleration curves

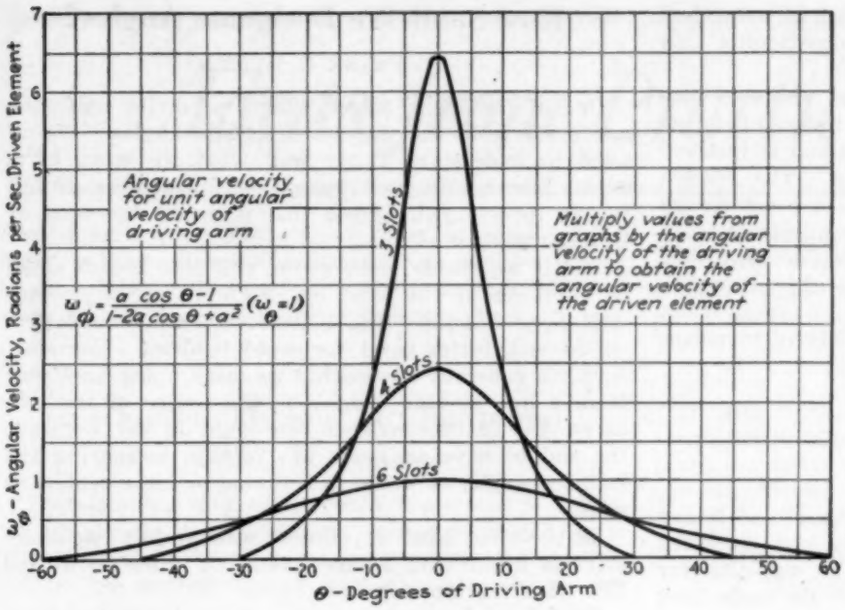

Angular velocity for unit angular velocity of driving arm
$\omega_\phi = \frac{a\cos\theta - 1}{1 - 2a\cos\theta + a^2}(\omega_\theta = 1)$
3 Slots
4 Slots
6 Slots
Multiply values from graphs by the angular velocity of the driving arm to obtain the angular velocity of the driven element
ω_ϕ - Angular Velocity, Radians per Sec. Driven Element
θ - Degrees of Driving Arm

Fig. 4—Angular velocity curves

$a_{\phi max.} = 4.39 \times 5.41 = 23.80$ radians per sec.²

From equation (1)

$$T = Ia_{\phi max.} = Fd$$
$$= 49.6 \times 23.80$$
$$= 1{,}180 \text{ ft.-lb.}$$

$$d = \frac{a - \cos\theta}{\cos\phi} \times \text{length of driving arm } AB, \text{ in ft.}$$

Length of driving arm = 1 ft.

$$d = \frac{0.43436}{0.90875} \times 1 = 0.478 \text{ ft.}$$

$$F = \frac{T}{d} = \frac{1{,}180}{0.478} = 2{,}470 \text{ lb.}$$

If, in Fig. 6, d_1 is the moment arm of the force F about the axis of the driving arm AB, then,

$$d_1 = AB \times \cos(\theta + \phi)$$

and the torque T_1 of the driving arm is then,

$$T_1 = F \times AB \times \cos(\theta + \phi)$$
$$= 2{,}470 \times 1 \times \cos(11° 31' + 24° 40')$$
$$= 2{,}470 \times 1 \times 0.80713$$
$$= 1{,}993 \text{ ft.-lb.}$$

The angular velocity of the Geneva disk at the point of maximum acceleration is 1.69 radians per second for unit angular velocity of the driving arm. The actual angular velocity of the disk is then $1.69 \times 2\pi/3$ radians, or 3.53 radians per second.

The torques T and T_1 are inversely proportional to the angular velocities.

$$\frac{\text{Torque of the driving arm}}{\text{Torque of the Geneva disk}} = \frac{\text{Angular velocity of Geneva disk}}{\text{Angular velocity of driving arm}}$$

$$\frac{1{,}993}{1{,}180} = \frac{3.53}{2.09}$$

The angular velocities are inversely proportional to the moment arms.

$$\frac{\text{Angular velocity of Geneva disk}}{\text{Angular velocity of driving arm}} = \frac{d_1}{d}$$

$$\frac{3.53}{2.09} = \frac{0.807}{0.478}$$

The Geneva disk, having completed one-half of its cycle and having attained its maximum velocity, has acquired kinetic energy.

$$K.E. = \frac{I\omega}{2} \text{ ft.-lb.}$$
$$= \frac{49.6 \times 5.06^2}{2}$$
$$= 635 \text{ ft.-lb.}$$

This energy must be dissipated in $\frac{3}{8}$ of a second before the turret can come to rest, since the arm makes one turn in 3 seconds and 45 deg. is $\frac{1}{8}$ of 360 deg. This energy amounts to

$$\frac{635 \times 8}{550 \times 3} = 3.08 \text{ horsepower.}$$

By applying a brake to the Geneva disk at the proper time, this kinetic energy may be absorbed and a reversal of stress in the driving mechanism prevented.

If the roller had but one guide, the table, after having turned through 45 deg., would travel at a faster rate because it now has attained an angular velocity of 5.06 radians per second as against the constant angular velocity of 2.09 radians per second of the driving roller, or almost $2\frac{1}{2}$ times as fast. Hence the Geneva disk would move away from the roller. As the roller, however, travels in a slot, from then on the turret drives the driving arm and the stress on the roller pin is reversed.

As the force on the roller pin varies as the square of the angular velocity, it follows that if the speed of the driving arm is increased from 20 to 30 r.p.m., an increase of 50 per cent, the stress on the roller pin will be increased in the ratio of $\left(\frac{30}{20}\right)^2 - 1 = 1.25$, or 125 per cent. Conversely, if the speed is reduced to 10 r.p.m., a reduction of 50 per cent, the stress on the roller pin will be only $\left(\frac{10}{20}\right)^2 = 0.25$, or 25 per cent of the stress at 20 revolutions per minute.

There are a variety of locking devices for the disk

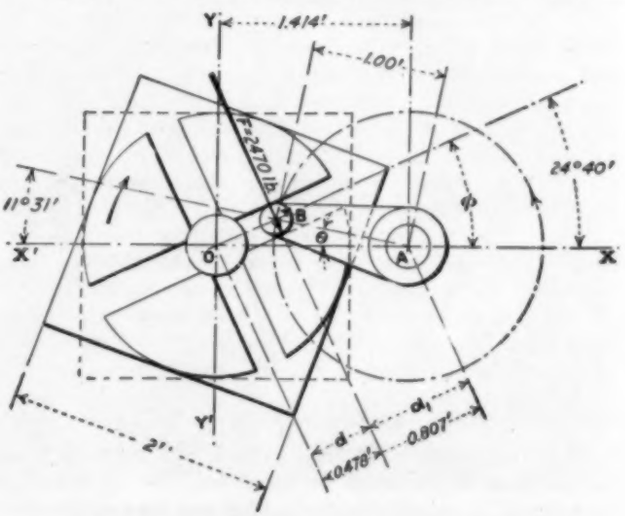


Fig. 6—A specific problem solved in the text

in use and the inertia reaction of the disk at the end of its stroke should be considered in proportioning this locking mechanism.

A 3-slot movement should be avoided wherever possible particularly where the mass to be indexed is large. This conclusion is born out by practice and is justified by a study of its acceleration curve. The sudden increase in driving power necessary in a 3-slot design is nothing short of a shock and is very destructive to the driving mechanism. If a sufficient portion of the driving cycle is available for indexing this drawback may be eliminated by adopting a 4-slot or even a 6-slot movement and driving the body to be indexed by means of suitable gears from the Geneva disk.

Jim and Henry

BY ENTROPY

I asked Jim this morning what he thought of Henry Ford's theory that it is necessary to give workmen leisure time in which to work up an appetite for luxuries, flivvers among other things. He came back at me with this, "When you and I were boys they had a saying that I thought was part of the Bible—'Satan finds mischief for idle hands to do.' Now it seems that this is not a quotation from the Bible but from some old puritan who thought everything that was comfortable was sinful. But, however, that may be, I always found that my wife and daughters could think up plenty of things to buy without my having to take any time off to do it."

Jim isn't quite so pessimistic as he sounds. Of course, almost everyone realizes that the time has come when if everybody worked the old sixty-hour week, and worked it at top speed with the labor saving machinery that we now have, the demand in some lines would be so over-supplied that selling prices would drop to a point where no one who worked for a living making them could afford to buy them with the wages he could earn. It is rather a jolt, however, for us to hear from the world's richest man that we fellows who build lathes and planers for a living ought to take enough time off to make the base ball and automobile business good. In fact it is just possible that he did not mean us at all. His profits seem to have been handed to him by the men who designed and built the machinery that makes it possible for him to turn out a couple of million flivvers a year. Probably there is no objection on his part to anyone of us sitting up nights and occasionally giving up a Sunday to designing a machine that will save five minutes time per fliv. At his old rate of $5 a day that would save him around $100,000 a year, and while it is hard to see just what good the money would do him, no doubt he would look on it as a duty to save it.

What gets me, however, is just how machine tool builders are going to cash in on the benefits we have conferred on humanity. Somewhere around 99 per cent of the present ease of life has been made possible by better machine tools, and yet you don't see many machine tool builders dying so rich that people fight over their estates.

The limitations of a man's work are reached when he becomes dissatisfied or loses interest in what he is doing. To avoid dissatisfaction and loss of interest, it is necessary to have congenial working conditions.

How Shall We Designate Angles?

BY FRANK C. HUDSON

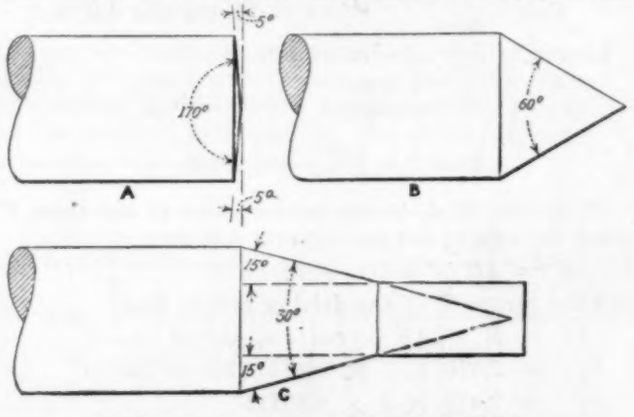
One of the many places where we invite confusion and error is in the way we designate angles. We all seem to understand fairly well what we mean by a 60-deg. thread or a 60-deg. angle for a lathe center. We are pretty well agreed that it means the total or included angle.

But if we decide to bevel the end of a bar or collet or anything of the kind, we begin to speak another language. We say "Bill, I don't want that bar square on the end, better bevel (or cone) it about 5 degrees." And Bill generally knows that we mean 5 deg. each way from a line at right angles to the center of the bar, as at *A*. To be consistent we ought to say we want the end to have an angle of 170 deg. measuring the included angle, as we do in a thread or lathe center, as at *B*.

On the other hand, suppose we want to join two diameters of a bar with a taper, as at *C*. How do we tell Bill what the taper is to be?

That depends on who we are and where we are. Some say "join the two diameters with a 15 deg. taper," meaning the angle each side of the center line. Others tell Bill to make a 30 deg. taper between the two sizes. And Bill makes fewer mistakes than we have any right to expect under the circumstances.

Still another complication is the way in which compound rests are divided or graduated. The most common way seems to be to have zero in the center and



Different ways of designating angles

run to 45 deg. each way, which is quite natural. But the lathe man who believes figures can't lie, sometimes goes astray because he doesn't think far enough ahead or because his instructions are not clear enough.

In this case, setting the compound rest to 5 gives him 5 deg. from squareness across the ends, as at *A*, or 170-deg. included angle. But if he wants to set the compound rest to turn a 60-deg. lathe center, he is out of luck if he expects to find 60 in the divisions. Here he has to know that the full angle must be divided by two, and the rest must be set to 30.

Perhaps, as we all agree on the included angle for threads and lathe centers, it would be logical to adopt that method for all angles. But I wouldn't even insist on being logical, if we can avoid unnecessary confusion. For confusion means spoiled work, delays in production, added costs, wastes with no comeback, ill feeling, and a lot of other annoyances. Isn't it worth while thinking about this angle designation?

Ideas from Practical Men

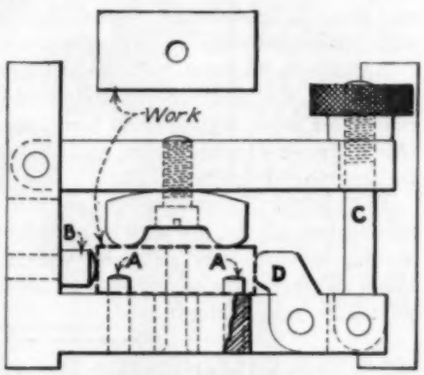
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Simple Method of Clamping

BY NORMAN E. BROWN

The clamping method herewith illustrated is handy for the purpose of securing small pieces of work in jigs. The device is fairly simple, and can be operated quickly.

With the method applied to the jig here shown, the work is dropped between four locating pins, two of which may be seen at *AA*, and pushed back against the stop pin *B* in the side wall of the jig. The cover, or latch, is then turned down to enclose the piece and the swivelling bolt *C* swung into the open slot in the end of the cover. An equalizer may, if desired, be attached to the underside of the cover, as here shown, to distribute the pressure evenly upon the work.



A simple clamping jig

When the thumb-nut is turned, pressure is brought to bear not only upon the top of the work-piece, but at the same time, by means of the offset lever *D*, the work is pressed against the stop pin *B*, thus holding it firmly in two directions with but one fastening.

Nicked Hacksaw Blades—Discussion

BY ARTHUR SILVESTER

On page 30, Vol. 64, of the *American Machinist*, D. A. Rogers in an article under the title given above, says a saw blade having several teeth broken in one spot, is generally scrapped, because if any attempt is made to use it, the tooth at *A*, Fig. 1 in his article, will have to take a bite equal to its length, and will most likely be broken by the shock.

The remedy he suggests is to grind off three teeth at an angle, as he shows. To my mind there would be only one justification for that method, and that is if there was no other saw blade available. The cost of a new blade is trifling, and it is not economy to try to use a blade broken in the way Mr. Rogers shows. A power hacksaw is made to work at a stated feed and speed, based on the assumption that each tooth is doing its share of work.

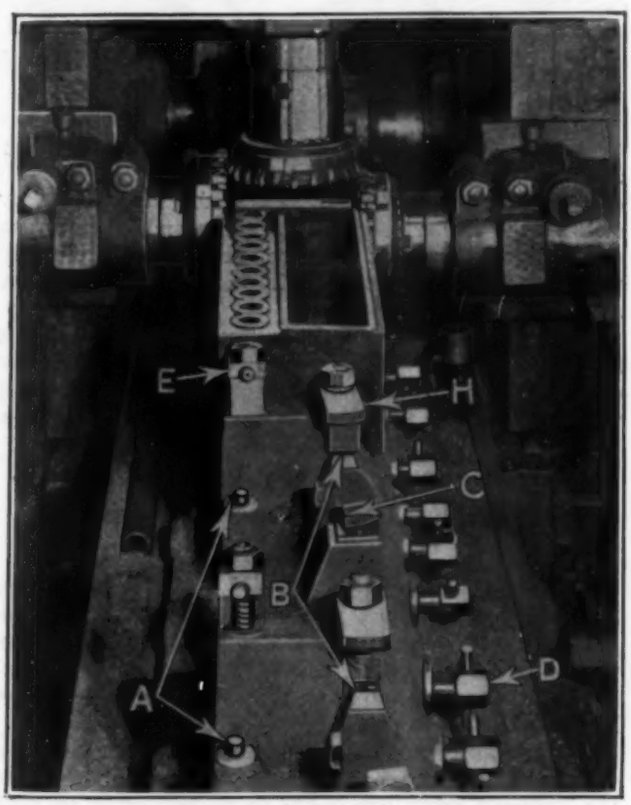
If three teeth are broken and three more are ground away, it will take longer to cut through the work, since there are fewer cutting edges, and those that are left are less efficient.

Rough and Finish Milling Cylinder Blocks at One Pass

BY FRANK C. HUDSON

The idea of roughing and finishing work at one pass by using two sets of tools is not new. We have been trying it for years. But the results were not always satisfactory, largely because the machines were not heavy enough or stiff enough to keep the ways in line during the roughing cut. With the advent of the large, planer-type milling machines with their heavy beds and stiff tables, the two cuts are now possible, by spacing the cutter heads so that the work clears the roughing cutters before the finishing cutters begin to cut.

The illustration shows the arrangement of the cutting



Machine arranged for rough and finish milling at one pass

heads for milling cylinder blocks, the roughing heads being in front and the finishing head at the back. It also shows the type of fixtures used. The block rests on the hardened pins *A* and the blocks *B*. It is held down by the hook clamp *C*, operated by the screw *D*, bearing against its lower end. Clamps *E* and *H* also help to hold it in position.

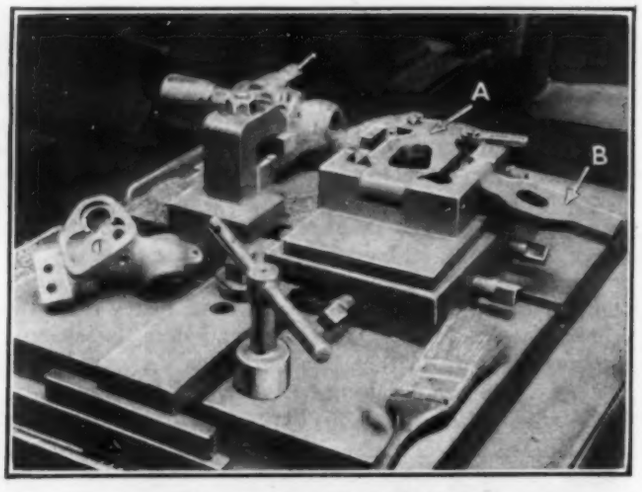
This method is in use in the shop of the Cleveland Automobile Co., Cleveland, Ohio.

Multiple Guide for the Profiling Machine

By Milton Wright

A multiple, or leaf, guide for the profiling machine, by means of which two different contours can be profiled at one setting of the work, is shown in the illustration.

After completing the operation for which the former *A* is used, the former is folded back on its hinge and the former *B* substituted for it by merely turning it



Leaf guide for profiler

over. Other shapes may be substituted by driving out the pins upon which the formers fulcrum and replacing the formers with others.

A development of this idea is readily apparent. By making the holders somewhat larger and of different shape the number that could be used upon one piece of work could be increased, possibly to five or six if that number should be desirable.

Note that the holder floats upon the base of the fixture. A tenon extends into a larger rectangular opening in the base so that the holder can be positioned with reference to the work by means of the setscrews.

Maintenance of Motive Power on New England Railroads—Discussion

By L. King

The article under the title given above, by Ellsworth Sheldon, and published in the *American Machinist*, on page 239, Vol. 64, gives particulars of gas-torch repair work on cast-iron parts, using Tobin bronze and manganese bronze, depending on whether the repaired part has to stand up to stress or wear.

Such repairs can as a rule be made with an assurance of success, but unexpected difficulties may arise where the repaired parts are liable to be subjected to high temperatures, owing to distortion by the unequal expansion of the original and the added metal.

A particular example of this occurred within the writer's experience, on locomotive work, and it illustrates the temperature effect.

The work done was building up the side and end strips for balanced slide valves, which were badly worn, and for which spares were not immediately available. Tobin bronze was used, and the strips were built up, machined, and bedded in, and the locomotive was back in service in quick time.

Trouble was immediately experienced from leakage, though a test had been made with compressed air before leaving the shop and was perfectly satisfactory. At the first opportunity the valve chests were opened for examination. It was then found that appreciable wear had taken place at the ends of the strips, while the center portions were apparently not bearing.

On checking on the surface plate, however, they still appeared in good shape, though a suggestion of daylight at the ends gave the clue to the trouble. To prove that we were on the right track, one of the strips was heated in a hardening furnace to approximately steam temperature, and again tried on the surface plate, when the previous result was reversed, the ends now bearing, and the center showing several thousandths clear, which corresponded to the condition when under steam.

Reference to any of the standard handbooks will show that the relative expansion of ordinary brass and cast iron when exposed to heat, is as ten to six, and this difference, with steam at 380 deg. F., was sufficient to bend the strips when hot.

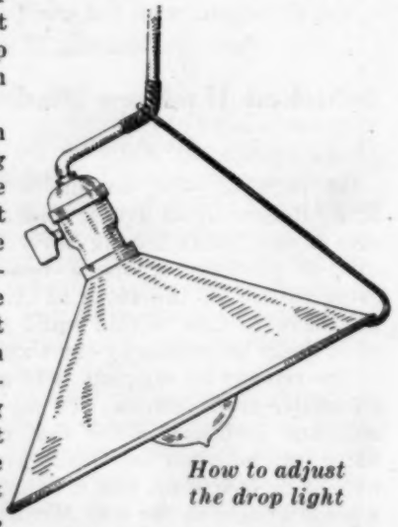
In this particular case, the difficulty was overcome by machining off the surplus bronze from the backs of the strips, leaving only pads on which the springs could bear, and refitting the working faces. The result was a perfectly satisfactory job.

Adjusting the Drop Light

By Richard C. Tarr

When the ordinary drop light, partially covered by a shade or reflector, throws a glare into the eyes of the workman or onto the work bench or machine, it annoys the workman and slows up his production.

The direction of the light can be controlled by the use of a piece of stiff wire bent and hooked at the bottom of the reflector and around the light wire above the lamp socket, as shown in the sketch.



How to adjust the drop light

Care should be taken to wind insulating tape around both the hook and the light wire where they come in contact. This precaution will eliminate the danger of a short circuit. The lamp can be tipped to any desired angle, by using wires of different lengths. Hooking the wire under different parts of the shade rim, will change the direction of the light. Thus the workman has the illumination of any part of his work under his direct control.

Decimal Equivalents

1/64 = .015625	33/64 = .515625
1/32 = .03125	17/32 = .53125
3/64 = .046875	35/64 = .546875
1/16 = .0625	9/16 = .5625
5/64 = .078125	37/64 = .578125
3/32 = .09375	19/32 = .59375
7/64 = .109375	39/64 = .609375
1/8 = .125	5/8 = .625
9/64 = .140625	41/64 = .640625
5/32 = .15625	21/32 = .65625
11/64 = .171875	43/64 = .671875
3/16 = .1875	11/16 = .6875
13/64 = .203125	45/64 = .703125
7/32 = .21875	23/32 = .71875
15/64 = .234375	47/64 = .734375
1/4 = .25	3/4 = .75
17/64 = .265625	49/64 = .765625
9/32 = .28125	25/32 = .78125
19/64 = .296875	51/64 = .796875
5/16 = .3125	13/16 = .8125
21/64 = .328125	53/64 = .828125
11/32 = .34375	27/32 = .84375
23/64 = .359375	55/64 = .859375
3/8 = .375	7/8 = .875
25/64 = .390625	57/64 = .890625
13/32 = .40625	29/32 = .90625
27/64 = .421875	59/64 = .921875
7/16 = .4375	15/16 = .9375
29/64 = .453125	61/64 = .953125
15/32 = .46875	31/32 = .96875
31/64 = .484375	63/64 = .984375
1/2 = .5	1 = 1.

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Production in Heat-Treating

Q. In placing the heat-treating department on a production basis, how can we judge whether or not we are getting the right output?

A. You can time-study heat-treating operations in a manner similar to any shop operation, providing that your time-study man has good judgment and a knowledge of heat-treating methods. Heating rates have been worked out, though these can only be taken as a basis for comparison. For example, low-carbon steel for forging is heated at the rate of 20 min. per in. of diameter, and steel for heat treating is calculated at 30 lb. per sq.ft. of hearth area per hour.

By analyzing each job, your time-study man ought to be able to establish time allowances for handling, heating, soaking, and quenching or cooling, according to the work and type of furnace. Before starting, however, it might pay you to have a furnace expert look over your equipment to ascertain if it is of the right capacity for efficient work.

Recommending Screw Threads

Q. I have to make a report and recommendation on screw threads, and would thank you for an opinion on the relative merits of the United States Standard and Whitworth threads. What, in short, are the principles involved, and when should one be recommended?

A. The form of thread is determined by the character of its service. The important differences between square, modified and triangular threads are in the relative strengths required, the friction of operation, and in the ease of manufacture. The square thread, for example, is generally recognized as the form best adapted for power transmission, and the triangular thread is now almost invariably employed for screws used in holding.

In essential principles the United States Standard and the Whitworth threads are almost identical. The 60-deg. angle of the U. S. S. thread is much more convenient for calculation and for cutting than the 55-deg. angle of the Whitworth, and is therefore to be preferred.

Since the sharp apex of the V-thread is liable to injury and more difficult to manufacture, the form has been modified in the U. S. S. thread by flattening the top, and in the Whitworth thread by rounding it. A gain in strength of the screw is then made by filling in the bottom of the thread to correspond with the top. The curves in the Whitworth form of thread cannot be made as easily or as accurately as the flats on the U. S. S. thread. The wear on the U. S. S. thread is also less than on the Whitworth because the pressure is uniform over the entire surface, while it is varying on the curved surfaces of the Whitworth. Theoretically the U. S. S. thread is a trifle weaker than the Whitworth, due to the sharp corners at the bottom of the former as compared with the rounded surfaces of the latter, but in actual practice this advantage of the Whitworth is likely to be more than offset by the better distribution of pressure on the sides of the U. S. S. thread.

We do not see any reason for recommending the Whitworth thread for use in the United States. You would be introducing another standard, as well as a source of trouble from the difficulty of replacement, without getting any material advantage.

Returning Tools to the Storeroom

Q. What is the best method to get employees to return tools to the store or toolroom when they get through using them?

A. A method which has been found successful is to have the tools kept in a closed toolroom, and issue them only on numbered checks. No shop with more than three workmen is too small to have a toolroom with an attendant. The toolroom should have a definite shelf, bin, or hook for each tool. Each workman is issued half a dozen checks in order that he may draw more than one tool at a time. The check consists usually of a brass disk about an inch in diameter with the workman's number stamped on it, and a hole punched in it so that it can be hung up in the place of the borrowed tool.

Workmen are never permitted within the toolroom. Usually the attendant hands out the tools through a window, and receives the check in return. The numbered check in the spot where the tool is stored shows at once where it can be found, and no time is lost looking for tools. The workman whose number is on the check is responsible for the tool if it is lost while outside of the toolroom.

The toolroom attendant inspects the tool upon its return to see if it is damaged. If it is broken he requires a release from the workman's foreman to show that the tool was injured from the "wear and tear" of service, and not due to the carelessness of the workman. In some shops the apprentice boys take turns acting as toolroom attendants, but in a large shop it will pay to have a capable man in charge who will fill in his time by sharpening and repairing the tools.

Welding with Thermit

Q. Recently I noticed your explanation of the process of welding pipe with thermit. Will you please explain the action of thermit in making the weld?

A. The thermit process of welding iron or steel depends upon a simple chemical combustion. Aluminum has a high affinity for iron oxide, and when these two substances in powdered form are mixed and ignited, the resulting rapid chemical action raises the temperature of the adjacent metal to about 5,400 deg. F. As this temperature is considerably above the melting point of iron, it is sufficient to cause a thorough weld when properly applied.

Technical Abstracts

Motion Study

Two of the major factors of motion study are the elimination of unnecessary motions in a cycle of motion and the utilization and alteration of the necessary ones to produce a given unit of work in the minimum time and with the least expenditure of energy, with due consideration to the surrounding conditions, tools and equipment. In this particular study a complete process route of folding 16x16-in. shingles is given and analyzed by each suboperation with the aim of eliminating unnecessary motions and unnecessary fatigue. The results show an increase of 12 to 20 per cent in the rate of production. The cost of folding the shingle has been reduced 23 per cent. The earnings of the men have been increased on an average of 55 per cent. Joseph A. Piacitelli, Barber Asphalt Co., in *Manufacturing Industries*, April, 1926, p. 281.

What the American Worker Wants

"For a long time," says Sam A. Lewisohn, vice-president, Miami Copper Co., "American industry has been preoccupied with the idea of co-operation between employer and employee. Too often, however, management has waited until trouble was brewing before it turned its attention to the co-operating idea. Then it built up temporary edifices to cope with the situation; conciliation boards, industrial courts, impartial chairmen and the like. These are good in themselves, but they are useful merely for treating symptoms. They do not go to the root of the problem.

A good engineer does not build a machine with the idea that it is not going to work, that it continually will need patching up. He gives time, attention and thought to his problem, studies the plans of his peers and superiors who have had to cope with a similar situation, and changes them to meet his own conditions. To the degree that he is successful, he is a good engineer. If his machine continually breaks down, he knows he has muffed his job.

"If he gives the worker justice, status, opportunity, all will be well. There will be small need for conciliation boards once that is achieved."—Rose Feld in *Trained Men*, Jan.-Feb., 1926.

Reclaiming Locomotive Main Rods

A steel back and main rod strap is difficult to hold securely. In time, owing to repeated reaming at each shopping, the holes become so large that both the rod and strap are weakened so that they cannot be continued in service. However, these holes can be refilled with thermit steel and the rod reclaimed. The stub end of the rod is thoroughly cleaned and three wooden plugs are driven into the holes at the small end of the taper. The rod is then placed so the plugs are on the bottom. A ¼-in. sheet steel box 14 in. long, 10 in. wide and 14 in. deep, is set on the end of the stud so that there is a clearance of about 2 in. between the rod and the bottom of the box to allow for the ramming of the sand under the rod. This box serves to hold the mold which is built around the rod. The rod with the box and mold is then inserted into an oil furnace and allowed to heat for about two hours to bring the temperature to about 1,550 deg. Fahrenheit.

While the rod is heating the welder prepares his crucible. About 40 lb. of railroad thermit is charged into it. The rod is then removed from the furnace, leveled and all particles of sand and scale blown out of the holes. The reaction is started and 25 to 30 seconds later the crucible is tapped. The plugs which have been burned during the preheating rise to the top, allowing the thermit metal to fill the impression made by them at the bottom of the mold. The weld is then allowed to cool for 14 hours.

The total cost of the operation including labor, cost of material and subsequent machining is $24.50 a rod. The cost of a new rod is approximately $136. Joseph Murphy, Boston & Albany R.R., in *Journal of the American Welding Society*, March, 1926, p. 19.

Blow-Pipe Cutting

The connecting rod on a steam engine is a heavy forging. Each end of the rod must be upset and then have a rectangular opening cut through to take the bearing brasses. These operations are best made with the oxy-acetylene blow-pipe, which in the hands of a capable operator, or by means of a straight line cutting machine, is able to remove the bulk of the metal quickly and economically. A templet is laid on the bar, the outline chalked, and the cuts made, thus bringing to a minimum the necessary machining.—*Oxy-Acetylene Tips*, April, 1926, p. 173.

Casting Bronze Gears

For many years it has been standard practice to make bronze worm gear blanks of an alloy known as stone bronze, composed of about 89 per cent of copper, 10 to 11 per cent tin, and minute quantities of phosphorus. Increasing requirements have brought about a necessity for further improvement in the alloy and it has been found that gear blanks cast in green sand from patterns are better than those cast in dry sand.

To increase the chilling effect on the face or periphery of the gear blank a ring of iron or other chilling medium gives excellent results. Furthermore, both sides of the blank are chilled at the same time. This gives an improvement in physical properties of about 20 per cent over the blanks chilled only on the face or periphery.

The alloy found best in this process is known as "B.B.D.C.," an alloy consisting of 88½ per cent copper, 10 per cent tin, 1 per cent nickel and ½ per cent each of lead and phosphorus.

Aluminum bronze lends itself well to the die-casting process. As the strength of the material is much more than that of tin bronze, the breakage of teeth is practically unknown. However, the bearing qualities of aluminum bronze will not withstand the application of so high a unit pressure as will tin bronze.—*The Iron Age*, March 4, p. 616.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

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A Welcome Settlement

READERS of the "American Machinist" on both sides of the Atlantic will breathe a sigh of relief at the sudden ending of the British general strike. This journal is not concerned with the politics underlying the struggle between the British government and organized British labor, but it is concerned with the effect of the strike on industry and the well-being of millions of individuals in industry. Much suffering has been avoided by the early settlement of what threatened to be a protracted deadlock and much financial loss has been prevented. Otherwise the strike has been productive of little that is good.

It is easy for American observers to say that the government made a serious blunder by doing thus and so—or that the labor people were guilty of poor strategy in calling a general strike when they did. The fact is that such opinions are about as worthless as a boring mill in a watch factory, for the American observers that really know enough of the conditions underlying British industrial relations to form sensible opinions are very few indeed—and the ones that are willing to talk are fewer still.

As this is written the miners are still out, and the transport men as well. There is also much bitter talk back and forth between employers and labor people, probably an unavoidable result of so profound an industrial disturbance. A test of strength between the extremists and the moderates has been imminent for some time. How long it will be before a real peace is declared is not apparent now but the interval is likely to be a considerable one.

It is to be hoped that the strike will have acted as a thunderstorm to clear the air and that the progress of the British people toward a condition of prosperity and happiness will not be further interrupted. Their problems are many and, though most Americans find it difficult to understand them, American sympathy and good wishes for their early solution are freely extended.

The Cost of Accuracy

ACCURACY is a term that has been juggled until it means little without actual dimensions that tell just what variation from exact dimensions are involved. With hand work accuracy is only secured at the expense of time and labor. With machinery it may be secured by the accuracy that is built into the machine but without undue time or labor on the part of the operator.

Making a precision lead screw, for example, may require a large amount of time and labor. But accurate threads may be cut with such a screw in the usual time required for such work. That great accuracy is possible in this line is shown by the small lead tolerance now permitted on high grade commercial taps.

There is an unmistakable tendency toward greater accuracy, or smaller tolerances, in many lines of machine work. A half thousandth is fairly common today and most shops now know what a half thousandth really is. A few years ago many of them only talked about it.

Builders of high class machinery and appliances contend that nothing but close tolerances should be permitted, that even what we call rough machinery would be better for fits that were more nearly alike, even though liberal allowances or clearances be desired. They also claim that it costs no more to secure this kind of work if proper equipment is provided.

The improvements in accurate machinery must be carefully considered before attempting to combat the advocates of smaller tolerances.

To the Pole by Airplane

ANOTHER conquest has been added to the achievements of the airplane by the successful flight of Commander Richard E. Byrd from Spitzenberg to the North Pole and return in 15½ hours of continuous flying. A journey that took Peary over a year has been accomplished by the airplane in less than a single day.

Commander Byrd and his aides deserve a full measure of credit for their accomplishment. Both as air pilots and as navigators they have proved themselves in the highest rank.

But we must not forget the engineers and mechanics who made such a flight possible. Credit for the means of which they accomplished their marvelous flight is international. It belongs to Fokker, of Holland, for the design of the plane and to the Wright engines, built in this country. Nor can we overlook the part played by the modern airplane instruments with which the plane was equipped. Without good design, workmanship and material, no engines or instruments can continue to function hour after hour as is necessary in a flight of this kind.

In our enthusiasm for the new method of transportation, let us not forget the "men behind the gun"—the men who make all mechanical achievement possible—the engineers and the mechanics.

Shop Equipment News

Hoefer Production Piston-Drilling Machine

The production piston-drilling machine shown in the accompanying illustration is being marketed by the Hoefer Manufacturing Co., of Freeport, Ill. It is intended for drilling the holes for piston pins in cast-iron or alloy pistons. The machine is one of a line of equipment for this purpose, of which one model was previously described on page 767, Vol. 64, of the *American Machinist*.

The machine consists essentially of the base, the trunnion, the roller bearing head and the hydraulic unit. The base of the machine is of ribbed construction. On the right- and left-hand side are mounted two standards, supporting the main shaft which is 5 in. in diam. The indexing trunnion, on which are located the sixteen work-holding fixtures, is mounted on the left side of the shaft.

Next is mounted the self-contained main head. The head is motor driven and its spindles and idlers are provided with roller bearings. The tools are mounted on the various spindles through Oldham couplings, providing a universal-joint drive. A perforated pipe is mounted on the inside periphery of the head and by means of a pump contained in a housing with its motor drive, a constant spray of oil is distributed all through the inside of the head. Adjacent to the head and fastened to it is the motor bracket holding the main driving motor used for supplying the power.

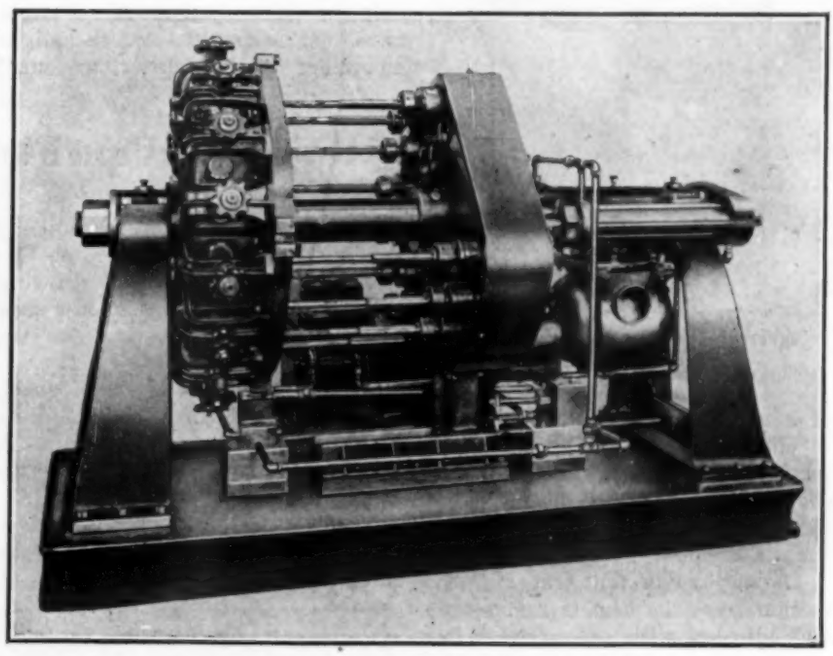
The feed on the machine is furnished through a hydraulic pump driven by means of an individual motor. Both the pump and the motor are mounted on a projection of the base so that the unit is self-contained. The cylinders for the feed are mounted parallel with the shaft, and just above the main driving motor. The piston rods are fastened directly to the main head. Advantages claimed for this method of feed are flexibility and ease of adjustment, as well as a factor of safety since the oil acts as a sufficient cushion to prevent damage to the machine in case any solid object accidentally interferes with the feed.

The indexing trunnion is divided in four quarters, each having four work-holding fixtures. The trunnion has attached to it four cams at these dividing points which, upon rotation of the trunnion, trip a pin that starts the work cycle, which is as follows: first, rapid approach; second, cutting speed; third, rapid reverse; and fourth, stop. Both the speed of the feed and the duration of each successive movement of the cycle can be easily adjusted. The machine cannot start until the operator has finished the loading operation and indexed the trunnion to its next working position.

The main head consists of three spindle groups of four tools each. The first group of tools consists of four boring bars, each of which can carry one or two cutting tools, as desired, according to the amount of metal to be removed. The second group of tools consists of four sizing reamers and the last group has four finishing reamers. If double cutters are used in the boring bars, four distinct operations are performed, two boring and two reaming, in order to insure accurate alignment and true holes.

The different holding fixtures are entirely independent from the machine itself, so that they are in no way dependent upon the latter for alignment and accuracy. Each of the fixtures is mounted on the trunnion on a large centrally located boss and held in place by means of four screws. Hardened and ground steel bushings are provided at the two extreme ends of the fixtures, and all cutting tools are ground to pilot in these two bushings. In view of the fact that the boring bars are driven through universal joints, they become a unit with the work-holding fixtures as soon as they have entered the guide bushings, and their accuracy is dependent only upon the accuracy of the fixtures.

By changing the fixtures and the boring bars, the machine can be adapted to any type or size of piston to be drilled.



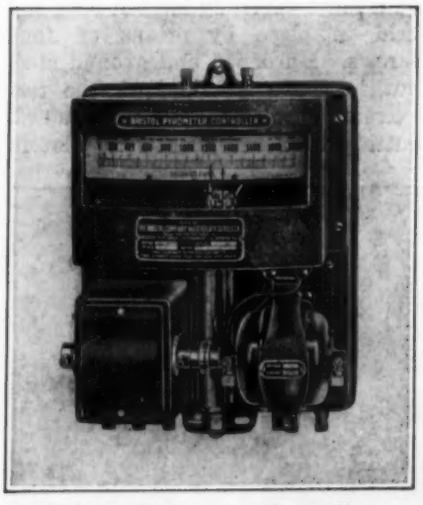
Hoefer Production Piston-Drilling Machine

Shop Equipment News

Bristol Pyrometer Controller, Model 479

The Bristol Co., Waterbury, Conn., is manufacturing the model 479 pyrometer controller illustrated. The instrument will control temperatures up to 3,000 deg. F. It is the intermittent-correction type.

A small motor drives the switch actuating mechanism and is controlled by a governor that is said to be positive in operation. All parts of the governor are dowelled to maintain permanent adjustment after being aligned. The axis of the motor is horizontal, and its shaft is connected to the camshaft by means



Bristol Pyrometer Controller, Model 479

of a non-metallic coupling in order to eliminate noise. The cam indirectly actuates the switch, which is caused to move up and down against the millivoltmeter pointer about four times a minute.

The mechanism that transmits the motion from the cam is first set up and adjusted with set screws, after which every joint is pinned. The plane of travel of the switch is made horizontal when the instrument is installed for operation, and other parts are adjusted to this reference plane. The pointer of the millivoltmeter swings in a parallel plane and its movement in this plane is said to be determined accurately so that the switch operates with certainty at any point of the scale. This precaution is necessary since the pointer tip, which is shaped like an inverted wedge and is called a steeple, has only a small amount of clearance between the switch points and the anvil plate in order to limit its movement when the switch is brought into contact. The base of the pointer is brought to rest against the anvil plate and the apex contacts with either one of the small switch buttons. It is claimed that there can be no lateral thrust on the pointer arm that could be transmitted to the pivots.

The top of the small buttons against which the steeple rests when the switch is making contact is a circle about $\frac{1}{4}$ in. in diam. A knife edge is placed in axial line with the index pointer and midway between the two buttons. The pointer is depressed on either side of this knife edge and there can be no neutral position. Hence with every contact the amount of heat supplied to the furnace is either increased or decreased.

It is claimed that actual tests have demonstrated that a slight movement of the pointer, too small to be observed by the eye, will decide whether the contact is made on the high or the low side. Hence it is said that the need for partial or set-back scales is eliminated.

The complete moving mechanism that supports the switch is assembled in a single unit, which is supported in a vertical bearing 6 in. in length. The switch-supporting mechanism is held up against the depressor arm by a stiff spring, which also supplies the power to raise the switch. The motor-driven cam forces the depressor arm down against this spring during the periods when the pointer is free.

The index pointer is set by means of a small knob that is inclosed behind a hinged door. When this door is opened, the switch mechanism is forced to its lowest position and the millivoltmeter pointer swings free. Hence the operator cannot damage the instrument by attempting to set the index pointer at the time that the switch is in contact with the pointer steeple. The scale is 7 inches.

Rockford Pipe-Flange Facing Machine

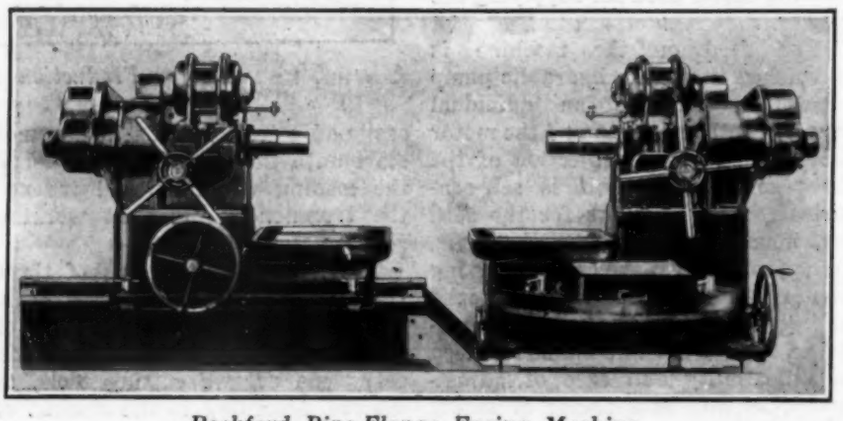
The machine shown in the accompanying illustration was built by the Rockford Drilling Machine Co., Rockford, Ill., especially for facing the flanges on large diameter pipe after the flange is welded on the pipe.

As can be seen in the photograph the machine consists of two units that are made to travel on I-beams so that long and offset pipe can be accommodated.

The left-hand unit is mounted so that it can be moved along the rails on I-beams for a distance of about 20 ft., parallel to the center line of the spindle. The right-hand unit is mounted on a swivel base so that it can be set at any angle with the left-hand unit. The rails for the right-hand member are set perpendicular to those for the left and allow about 20 ft. of movement.

A rack-and-pinion feed is used for traversing the two units along the beams. The traverse is operated by means of a large handwheel. The units can be clamped in position wherever desired.

Direct-connected motors drive the



Rockford Pipe-Flange Facing Machine

Shop Equipment News

spindle through reduction gears. Pick off gears are provided so that speed changes can be obtained. The spindle has a very short feed by hand only. The sleeve bearing in the head is provided with a clamping device so that the sleeve can be held rigidly in place. The spindle nose is made to accommodate a facing head such as the Mummert Dixon or a similar make of starfeed facing head.

The tables are made to suit so that the holding fixtures for clamping the pipe can be fastened to them. Each unit is equipped with a coolant pump, piping and tank.

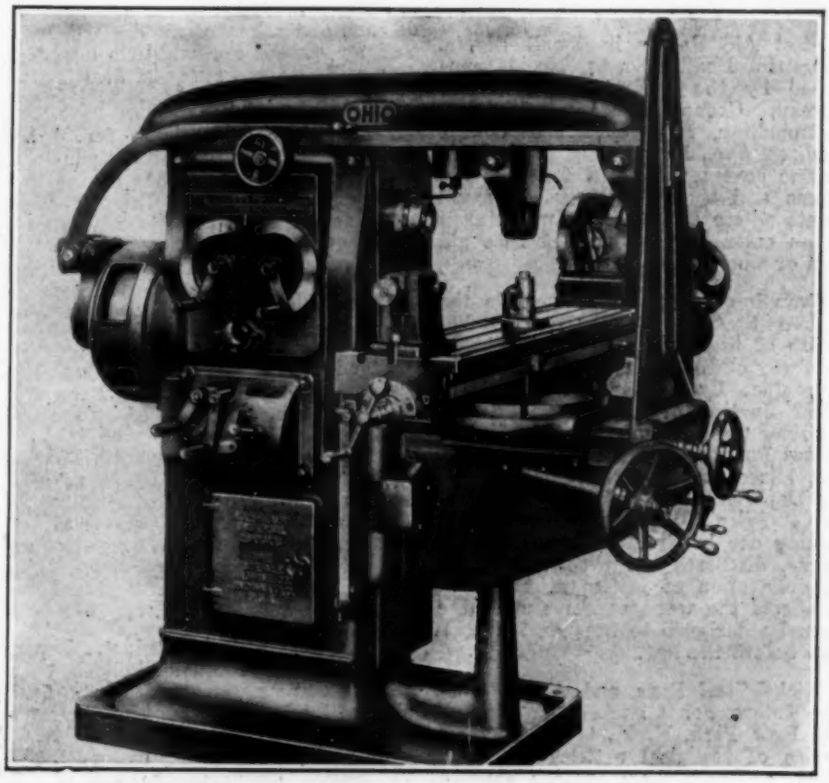
"Ohio" Improved Milling Machines

A complete line of improved milling machines has been announced by the Oesterlein Machine Co. in sizes No. 1, No. 2, No. 2 heavy, No. 3, No. 3 heavy, and No. 4. The accompanying illustration of the No. 2 heavy machine shows the outstanding innovation, which is the V-flat overarm.

The heavy cast-iron overarm of the machine is of rectangular cross section, with V and flat guides forming the bearing, and providing alignment of the arbor supports. The extra width of the overarm is also intended to give a more rigid surface to receive the upward thrust of the cut. The clamping of the overarm is done by means of a pair of T-slot bolts at the front, and another pair at the rear of the column. Each pair is equalized and clamped by means of a nut at the side of the machine. The whole design of the overarm is with the idea of giving maximum rigidity.

The overarm is equipped with a rack that meshes with a pinion in the column, and a handwheel on the end of the pinion shaft enables the operator to shift the overarm conveniently. For the replacement of arbors or cutters, the arbor supports are placed on the arbor, and the overarm is brought forward into position by means of the handwheel. Both sides of the overarm have finished gaging strips scraped parallel with the center line of the spindle. These surfaces may be used as gaging points for squaring work, or for the location of gaging blocks.

The lubrication is automatic. Oil seeps from a reservoir through felt and down tubing to the spindle, intermediate-shaft, and pulley bearings. It then passes through a second and third reservoir supplying other bearings.



"Ohio" Improved Milling Machine. No. 2, Heavy

Trade Catalogs

Balancing Machines. The Gisholt Machine Co., 1000 East Washington Ave., Madison, Wis., has published the Gisholt Precision Balancing Machine Treatise No. 2, entitled, "Dynamic Balancing Simplified." The booklet contains sixty-two, 8½x11-in. pages.

The contents of the booklet include general considerations in relation to dynamic balancing, the measuring and correcting of dynamic unbalance, the determination of the calibration constant, the Gisholt calculating rule and recording amplimeter, and advantages of the Gisholt method of balancing.

Many illustrations and drawings are used to illustrate the text which is well organized and prepared. The book is an attractive and readable one.

Conveyors. Standard Conveyor Co., North St. Paul, Minn. Catalog No. 5, illustrates and describes the uses and applications of Brown portable pilers, tiering machines, conveyors and elevators.

Short descriptions are given of each industry or condition to which it has been applied and the pages are very profusely illustrated with photographs of the installations. Line drawings show the specifications for the various types of equipment.

Dieheads. The Eastern Machine Screw Corporation, New Haven, Conn. A circular has been issued by Arthur Jackson, 32 Glenholme Ave., Toronto, 10, Canada, Canadian representative of the company, featuring applications of the H & G dieheads in Canadian plants.

Filters, Air. Drying Systems, Inc., 11 South Desplaines St., Chicago, Ill. A folder illustrating and describing its automatic self-cleaning "constant-effect" air filter has been published by this company.

Furnaces, Electric. Automatic & Electric Furnaces, Ltd., Elecfurn Works, 173-175, Farrington Rd., London, E. C. 1, England. Heat-Treatment Bulletin No. 36, describes the electromagnetic heat-treatment of alloy steels.

Gears, Worm. David Brown & Sons, Ltd., Lockwood, Huddersfield, England,

has published "Worm Gearing," a treatise on the design, manufacture and application of worm gearing and worm reducing units. This book, a companion volume to "Automobile Worm Gearing," contains ninety-two, 7½x10-in., pages on worm gears.

The book is divided into three sections. The first describes the properties and the manufacture of the "DBS" patent worm gear. The second section describes the design of worm gears in general, as well as this company's system of worm gear design. The third section is devoted to the use and installations of worm reducing gears and to a catalog of the units made by this company.

The book contains much valuable information on the subject and is well prepared.

Machinery. J. L. Lucas & Son, Inc., Bridgeport, Conn., have issued a May booklet (No. 66) briefly describing their method of servicing and detailing a long list of rebuilt machine tools: boring mills, lathes, drills, die sinkers, gear cutters, grinders, hammers, millers, planers, presses, automatic screw machines, etc. The list is indexed for easy reference, and prices are given. The booklet contains twenty-four, 4x9-in. pages.

Pumps. Morris Machine Works, Baldwinsville, N. Y. Bulletin No. 124 illustrates and briefly describes several models of this company's pumps driven by gasoline engines.

Pyrometers. The Brown Instrument Co., 4501 Wayne Ave., Philadelphia, Pa., has published its catalog No. 15 on pyrometers. The execution and the design of the booklet is unusually attractive. It contains eighty, 8x10½-in. pages that are profusely illustrated with photographs of the company's line of products as well as installations of the equipment.

The catalog describes in some detail the manufacture of the instruments, and this section contains many illustrations of different departments in the organization. The next section contains notes on applications and uses of pyrometer equipment in various industries.

The remainder of the catalog is largely devoted to very detailed descriptions of the types of instruments and accessories manufactured by the company. Each detail is illustrated with a photograph or drawing to make clear the text.

Reamers. The Gammons-Holman Co., Manchester, Conn., has issued a circular giving specifications for and describing the Gammons taper-pin reamer.

Valves. Homestead Valve Manufacturing Co., Homestead, Pa. Catalog No. 33, containing fifty-two, 6x9-in. pages, is devoted to the description of an imposing line of Homestead valves of various types.

Photographs, cross-sections and drawings are used to illustrate the descriptions which are detailed and thorough. Specifications of the valves are included in the descriptions of each model.

Welding and Cutting Apparatus. The Weldit Acetylene Co., Detroit, Mich., has issued Catalog C, which describes the Weldit equipment and accessories in thirty-six, 7½x10½-in. pages.

The catalog illustrates and describes welding and cutting torches, regulators, welding, cutting and leadburning outfits and miscellaneous equipment such as goggles, gloves and shields. The booklet is well illustrated.

Pamphlets Received

American Arbitration Association, Information Bulletin, No. 1. Published by the American Arbitration Association, 342 Madison Ave., New York, N. Y. This pamphlet contains information on the United States Arbitration Act, on methods of arbitration and rules and forms of procedure as well as on federal departmental activities, state legislation, and trade, commercial and professional organization developments.

Dimensional Changes Accompanying the Phenomena of Tempering and Aging Steels. By Howard Scott. An author's reprint from the Transactions of the American Society for Steel Treating, Cleveland, Ohio. The pamphlet, pages 277 to 304 of the Transactions, studies the cause and the means for controlling dimensional changes which are of sufficient magnitude to produce serious errors in precision gages.

First Aid Rooms in Small Plants. Industrial Health Series, No. 1, published by the Policyholders' Service Bureau, Group Insurance Division, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. This outline covers the needs for first aid rooms and their equipment in small plants where this work is undertaken as an emergency by trained first aid men or women.

Growth of Legal Aid Work in the United States. By Reginald Heber Smith of the Boston Bar and John S. Bradway of the Philadelphia Bar, with a preface by William Howard Taft, Chief Justice of the United States Supreme Court. Bulletin of the United States Bureau of Labor Statistics, No. 398, Miscellaneous series, published by the Department of Labor, Washington, D. C. Price 20c. This pamphlet, containing one hundred and sixty, 6x9-in. pages, discusses the problems of the administration of justice primarily as it affects the wage earner and of the agencies designed to improve his position before the law.

Nickel-Steel Data and Applications. The International Nickel Co., 67 Wall St., New York, N. Y., is publishing a series of technical articles on nickel steel, gathered from various sources. The articles so far published indicate that the series will be found a valuable one collecting the most important and relevant material on the subject. No. 1 is entitled, "Society of Automotive Engineers Standard Specifications for Steels." No. 2 is on the physical and mechanical properties of nickel steels, while No. 3 is devoted to the heat-treatment and applications of nickel and nickel-chromium steels. The material was collected from the report of the Iron and Steel Division of the Society of Automotive Engineers, the Bureau of Standards and the Handbook of the American Society for Steel Treating, respectively.

Research Associates at the Bureau of Standards. Circular of the Bureau of Standards, No. 296. Published by the Department of Commerce, Washington, D. C. This circular gives a brief history of the research associate plan and a list of associates with the names of sustaining organizations and the problems under investigation. The purpose and accomplishments of the research division are described.

Safety Rules for the Installation and Maintenance of Electric Utilization Equipment. Handbook of the Bureau of Standards, No. 7, published by the Department of Commerce, Washington, D. C. Price 15c. This pamphlet consists of part 3 and the grounding rules of the fourth edition of the National Electric Safety Code.

Shall I Study Drafting? Published by its author, Robert W. Shelmire, 1417 Bordeaux St., New Orleans, La. Price 25c. This pamphlet containing sixteen, 5 x 7-in., pages is written to advise those contemplating drafting as a profession, as to the actual conditions in the field. It tells what the successful draftsman must know, the opportunity, demand and salary of the draftsman as well as reasons for which the tradesman will find the study of drafting to his advantage.

Standard Specifications for Low-Carbon Steel Splice Bars. Industrial Standards No. 4, published by the Department of Commerce. Price 5c. This pamphlet contains the Spanish as well as English text as adopted by the American Society for Testing Materials, and bearing the serial designation A3-24, on standard specifications for low-carbon steel splice bars.

Standard Specifications for Quenched Carbon-Steel Track Bolts. Industrial Standards No. 32, published by the Department of Commerce. Price 5c. This pamphlet is one of the Spanish-English series on standard specifications adopted by the American Society for Testing Materials. The publication, serial designation A50-24, contains specifications for the manufacture, properties, tests and inspection for quenched carbon-steel track bolts.

The Bonus and the Budget. Report No. 83, prepared by the Policyholders' Service Bureau, Group Insurance Division, of the Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. This booklet, containing eight, 8½x10½-in., pages, discusses the use of the bonus principle as an incentive to department managers and foremen to keep the actual expenses of their departments within the budget. It reports the plans used in several large companies and the factors to be considered in the paying of a bonus.

News of the Week

Addresses of High Quality Feature Gear Manufacturers' Convention

E. J. Frost re-elected president—Other officers continued—Attendance good —Committee to be appointed to formulate standard methods of estimating

From the president's opening talk through the papers on the last day, the addresses delivered at the tenth annual convention of the American Gear Manufacturers' Association were of uniformly high quality. The meetings were held at the Book-Cadillac Hotel, Detroit, May 13 to 15, inclusive. The attendance was 100 approximately.

The president, E. J. Frost, of the Frost Gear and Forge Co., in opening the convention, pointed out the paths to be followed by the association in future work. Mason Britton, manager of the *American Machinist*, and vice-president of the McGraw-Hill Publishing Company, spoke of obsolete versus modern equipment, under the title, "Are You Using Pre-War Stuff?" "Lifting the Veil of Oil Infections, or Saving Fingers and Dollars Through Control of Oil Infections," was the title of a paper by W. D. Price, service director of the Warner Gear Co. At the banquet, at which A. W. Copland was toastmaster, W. B. Stout, of the Stout All-Metal Airplane Co., forecast the future of aviation. Earle Buckingham, of the Massachussetts Institute of Technology, presented a paper, "Wear on Gear Teeth," (published elsewhere in this issue). "Gear Tooth Stresses" was the subject treated by S. Timashenko and R. V. Baud, research engineers of the Westinghouse Electric and Manufacturing Company.

E. J. Frost was re-elected as president for the ensuing year. A. F. Cooke, of the Fawcus Machine Co., B. F. Waterman, of the Brown & Sharpe Manufacturing Co., and C. F. Goedke, of the William Ganschow Co., were re-elected as first and second vice-presidents and treasurer, respectively. T. W. Owen, 2443 Prospect Ave., Cleveland, continues as secretary.

Four members were elected to be continued on the executive committee for a period of three years. They are:

A. W. Copland, Detroit Gear and Machine Co.

R. P. Johnson, Warner Gear Co.

Geo. L. Markland, Jr., Philadelphia Gear Works.

B. F. Waterman, Brown & Sharpe Manufacturing Co.

The Warner Corporation, of Muncie, Ind., was elected as a new member company. The executive representative is B. E. Johnson.

The Pratt & Whitney Co., of Hartford, Conn., was elected as a new member company. The executive representative is H. D. Tanner.

The Accurate Gear Corporation, of Brooklyn, N. Y., was elected as a new member company. The executive representative is Joseph J. Braun.

George M. Eaton was elected an additional associate representative of the Westinghouse Electric and Manufacturing Company.

Myra Hamilton was elected an additional associate representative of the Hamilton Gear and Machine Co. Miss Hamilton is the only lady member.

The *American Machinist* cup, given as a prize in the golf tournament, was won by R. S. Drummond of the Gear Grinding Machine Company.

Committee to Formulate Standard Methods of Estimating

A step taken by the association that may prove of great importance was the adoption of a resolution, "That a standing committee be appointed to co-operate with our committee on uniform cost accounting in making recommendations regarding average cost rates for all machinery used in gear manufacture, and to formulate standard methods of estimating; also to collect and furnish to the member companies example-estimates from time to time."

As shown in the report of the General Standardization Committee, made by B. F. Waterman, chairman, progress reports were submitted by practically all of the sub-committees.

The sprocket committee reported that there will soon be available for distribution a data sheet giving the standard practice in regard to sprockets for roller chains. The data are the same as those adopted by the A.S.M.E. and the A.E.S.C. Recommendations for further standards will be delayed pending action of the A.E.S.C.

A system of symbols for gear elements offered by the Committee on Nomenclature brought about a great deal of discussion and was referred back to the committee pending action of the sectional committee.

The progress report of the Herringbone Gear Committee stated that recommended practice is now under consideration by the sectional committee.

There is now a tentative American practice in regard to keyways. Hence the report of the Keyway Committee aroused extensive discussion. It was accepted as a progress report, recommendations being made that standards be provided for keyways for both square and flat keys, the A.G.M.A. and A.E.S.C. table to be expanded, with standards for keyways for square keys to be provided up to 4⅞ shaft diameter only. It was recommended to add a ⅞x⅝-in. keyway for shafts from 1⅞ to 1⅞ in., inclusive in diameter.

Standard nomenclature for the conventional 3-speed automobile transmission, according to the report of the Differential-Transmission Committee, is to be considered by the S.A.E. at its meeting this week. Work is now in progress on standard nomenclature for transmission housings and the committee is considering work on other than conventional transmissions.

The formula

$$Hp = \frac{0.000095 \times s \times fw \times y \times plv}{dp},$$

for computing the horsepower of non-metallic spur gears was adopted as recommended practice. It is to be used for spur gears composed of laminated phenolic materials or rawhide.

A system for straight-tooth bevel gears was submitted by the Bevel and Special-Bevel Gear Committee.

The following recommended practice for brass flanges for composition pinions was adopted:

For brass flanges for composition pinions the recommended practice is S.A.E. No. 40, a good cast red brass, of sufficient strength and hardness to take its share of load and wear under conditions of style No. 2 of the A.G.M.A. standards for composition gearing, a design in which the flanges mesh with the mating gear, and therefore ample for style No. 1.

The progress report of the Tooth Form Committee showed the following steps taken:

The 14½-deg. composite system full depth of tooth, which the association adopted at the last meeting, as well as the 20-deg. stub tooth involute system, is being issued as a proposed tentative American standard on spur-gear tooth forms by the Sectional Committee on the standardization of gears.

The committee is planning to propose an American full depth of tooth, 20-deg. pressure angle, at the next meeting.

Prospects look bright for a proposed basic hob form which should satisfy the various cutter makers.

Demand has arisen for data on 14½-deg. pinion-diameter enlargements. The

committee is working on a table for 14½-deg. full depth of tooth pinion-diameter enlargement similar to the herringbone gear 20-deg. table.

A progress report was submitted by E. W. Miller giving data and results of the first series of experiments made with the Lewis machine at M.I.T. covering the influence of error and elasticity on the strength of gear teeth.

It was reported that the last meeting of the Sectional Committee was held in New York City, Oct. 23, 1925, where reports were read on nomenclature, tooth form, helical gears, worm gears, and materials. The next meeting will probably be held in a month or so to discuss nomenclature, materials, and helical gears. A meeting of the Materials Committee of the Sectional Committee in Pittsburgh was announced for the 17th of this month.

Talks on Industrial Relations

In lieu of a formal report from the Industrial Relations Committee, several brief talks were given to outline the policies of a number of the member companies. Two conclusions can be drawn from the talks and the discussion: (1) that many of the gear manufacturers recognize the importance of industrial relations and are making definite moves concerning it; and (2) that there is a strong leaning toward giving a man all of his compensation in his envelope and not part of it in what is frequently know as welfare work.

In his able address, opening the convention, president Frost said, in part:

"I cannot refrain from again commending to your unabated gratitude, the zeal and devotion of the chairman of the General Standardization Committee. If you had followed through, as I have for the past year, copies of Ben's correspondence, you would marvel at the range of subjects covered and the immense amount of details gone through.

"We owe much to Mr. Waterman, his various chairmen and their loyal workers and we also should and do recognize the support rendered by the Brown & Sharpe Manufacturing Co., and many other concerns who are willing, (using a western mining expression) to 'grubstake' the industry by allowing their representatives in the A.G.M.A. to take time to do this work, trusting the future to make returns to them in bettered manufacturing conditions and a more stable industry.

"It is fortunate indeed that the old, self-centered, suspicious and egotistical manufacturer is fast being replaced by a new type whose business horizon can compass something for the other fellow as well as for himself.

"There are many things we yet can and should do as an industry organization.

"So far, we have not adopted any code of ethics to which we could and should all subscribe, and although I realize that for most of us no such guiding document is necessary, we can all appreciate that its influence for straighter thinking would be worth while. Failing in adopting one prepared to specifically meet our needs, we might do well to use the 15 articles set forth in 'Principles of Business Conduct' as formulated by the Chamber of Commerce of the United States.

"At the meeting last fall we heard a very able paper presented by Mr. Baltzly, of the Warner Gear Co., tending to prove that the assembler of automotive or other machinery could, with profit, purchase rather than make his own gears. This, in many instances, undoubtedly is true not only regarding price, but includes quality as well. It stands to reason that an organization trained and continually working on one line of endeavor should and does become more proficient than where the duties of the supervising force compel it to function by contracting with many dissimilar departments; where the laboratory has to deal with a multitude of metal alloys, to say nothing of paints, laquers, varnishes, fabrics and the like, and where the engineering force is spreading itself over a wide array of but remotely related subjects. It is incumbent, therefore, upon all of us to preach the gospel of specialization and to uphold our argument by seeing to it that right prices are maintained through efficiency and that quality is commensurate with the price paid.

"It has been quite common in the past for manufacturers to think in terms of their investments in material things such as land and buildings, machinery and inventories of goods either finished or in process, giving little consideration to that most vital item, human effort. The men of the shops do not want patronizing in the way of welfare work, club rooms, picture shows, reading rooms, and the like, unless they have a definite voice in their establishment, control and support. What they crave is a just recognition of the part they play in the great economic game and a fair share in its returns.

"We should carefully study our expansions so as to buy when prices are the lowest and more than all else have equipment all set, ready to go when the wave of improved conditions come. Few of use, however, have nerve enough to do this.

"At the last meeting we had a very profitable discussion after a paper on the subject of better steels, the idea being that we should ask the mills to produce material more free from impurities and segregation and that should be uniform in response to proper heat treatment. I still believe this to be a subject off primary importance to us and hope you will use every consistent effort to bring it to pass."

Equipment Problems

In his paper, "Are You Using Pre-War Stuff?" Mason Britton described briefly the policies of representative users of shop equipment in regard to buying new and modern machinery for additional capacity and replacement. (These policies have been explained in detail during the past year in the *American Machinist* in the series of articles, "Getting the Most Out of Your Machine Tool Dollar.")

Mr. Britton pointed out how the great load of increased production per unit of labor, that has taken place since 1914, has been shouldered by the machine; that the economic life of the machine is generally shorter than the physical life; and that it behooves every user of machines, if he wants to keep in the procession, to maintain his equipment at a high point of efficiency as to both condition and design. The keynote of his address was, "Be master of your machines! Don't let them master you! Throw out the obsolete, dollar-wasting, time-wasting, pre-war stuff!"

In "Lifting the Veil of Oil Infections," W. D. Price, service director of the Warner Gear Co., told of the experiences of his company in trying to find a germ-destroying agent that will live in cutting oil, a problem that he and co-workers have succeeded in solving.

A synopsis of Mr. Price's paper is as follows:

"We had experienced 60 cases of infections in ten months, 40 of which were among workers in cutting oil.

"New oil was pure—reclaimed oil was pure. We ourselves were contaminating the oil while using it.

"We discovered the conditions by pathological tests.

"We sought and found a germ destroyer that time has proved does not affect the functioning of the oil but makes of it a purifier. We found a method of measuring the deterioration of our germ destroyer and we arrived at a proper formula for maintaining the correct amount at varying temperatures.

"We learned the relationship of pus-forming sores to infections.

"We have eliminated hair-follicle oil-rash from our plant.

Elevating the Wiping Rag

"We found the wiping rag common property and a common germ carrier even when newly purchased. We elevated the wiping rag to the handkerchief class and eliminated that germ carrier from our midst.

"In all, we have eliminated oil infections and our compensation insurance rates have been reduced.

"These results, it is true, were obtained at some expense, but the cost is low compared to what one gets out of a factory where one's workmen are healthy, happy and vigorous.

"The knowledge, too, that through grim determination we have been able to alleviate pain and suffering and even prevent death, and added to that fact, that production was not affected, also lies well on our conscience."

In their paper, "Gear Tooth Stresses," presented by Mr. Baud, S. Timoshenko and R. V. Baud, research engineers of the Westinghouse Electric and Manufacturing Co., discussed the stresses and deflections in gear teeth. The data were obtained by the use of the photoelastic method to study the stress concentration at the root of the tooth and to establish the factors of stress concentration for various radii of the fillet.

By the use of the Herz theory the local stresses at the surface of contact of two teeth in mesh were discussed and it was shown that the most unfavorable conditions exist at some depth beneath the surface of contact. Equations were given for calculating the deflection of teeth and it was shown that this deflection is usually less than the inaccuracies in commercial gears.

Mr. Stout gave a very bright picture of the future of the airplane industry in America. The following paragraphs are a brief summary of his statements:

Flying is becoming an industry of transportation. The Ford commercial lines between Chicago and Detroit and between Cleveland and Chicago traveled a distance equivalent to more than 100 times around the earth last year, with no accidents. Transportation is the key to every industry and is the greatest fundamental industrial factor outside of agriculture. It has the most effect upon the mode of living.

Nations can think only as fast as their transportation. With each development in transportation comes a newer, broader, outlook for humanity. Accompanying the development of the railroads, and making their efficient use possible was the telegraph. The telephone accompanied the automobile. Now the wireless and radio are accompanying the airplane.

The railway trains travel on limited roadways. the automobile travels on a network of roads, but the airplane will travel on an unlimited ocean. The airplane will extend the accomplishments of the automobile, which brought into existence a thousand industries, made necessary a knowledge of heat-treatment, and caused us to develop materials specifications. It proved our theories of economics wrong, showing us that not thrift, but earnings, are the basis of wealth, and that the wealth of any nation is proportionate to its production of luxuries, which in time are changed into essentials.

The airplane will bring about a United States of Europe as a result of its complete independence of boundaries. The air laws are now the only ones standardized among nations in Europe.

Following Mr. Stout, T. P. Horsburgh, of the Horsburgh & Scott Co., showed several reels of extremely interesting travel pictures taken by himself and party on a six-months journey through U. S. possessions and foreign countries.

Conscious Co-operation and High Wages Are Subjects of Discussion at U. S. Chamber of Commerce Convention

Secretary Hoover, Governor Ritchie, Owen D. Young and Julius H. Barnes address members

Conscious co-operation on the part of business men and other members of a community and the acceptance of the doctrine that high wages are conducive to continued prosperity were stressed by speakers at the 14th Annual Meeting of the Chamber of Commerce of the United States at Washington, May 10 to 13. Registration reached something like 3,000.

As a preliminary to the main meeting, the American Committee of the International Chamber of Commerce gathered on Monday to listen to Owen D. Young, Sir Josiah Stamp and Julius Barnes on European reconstruction and debt payments. Sir Josiah announced these principles of reconstruction and then applied them to various countries. He said, "The work of reconstruction has three distinct statements; reconstruction, construction, fruition. There must be clear recognition that a particular state of affairs will not mend itself and demands conscious efforts by agreement with fundamental economic principles, that mere wishes and desires are not principles. The need for definite aims and concerted efforts must become insistently voiced.

"In the second stage, construction, a scheme of reform must be elaborated, divergent interests considered and finally chosen from, and common concert and good will obtained for putting it into action.

"The third stage, diagnosis and prescription, is the most trying of all, because it calls mainly for the prosaic qualities, patience and endurance. Fruition is slow, halting, fitful it seems, if we stand close up to the problem day by day and are impatient of results."

Mr. Young pointed out that, no matter what arrangements were made for debt settlements by politicians, the business men of the world would have to find the means to make the payments.

At the first general session, on Tuesday morning, President John W. O'Leary read the annual address of the president in which he maintained that the problem of the farmer is the most pressing one now facing the United States. He went on to stress the importance of drastic self-regulation by business so that it may continue to merit the confidence of the country demonstrated by the reduction in government regulation.

Following the president's address Julius H. Barnes spoke on "Self-Government in Business." Mr. Barnes attributed America's economic supremacy to natural resources, habits of industry and stable and sound government, emphasizing particularly the advantageous position of American labor.

"American organized labor," he said, "this last year declared the measure of rightful compensation for the worker depended upon the production results of his labor. Thus was abandoned the old theories of a 'living wage' and the issue squarely joined with the European labor concept that the worker's daily performance must be restricted so that more days' wages must be paid to accomplish a given result. Recently America has been visited by delegations from the British Associated Industries and by the London Mail's delegation of trades union leaders from the engineering trades. Their reports express amazement at the American worker's standard of possession and living. The conclusions of both British employers and British workers state that both the progress of the worker and the prosperity of the employers rest on increasing production."

At the second general session on Wednesday, Gov. Albert C. Ritchie, of Maryland, was the speaker. He pointed out the need for more self-government in business and more business in government.

The high light of the meeting was the address at the annual dinner by Secretary of Commerce Herbert Hoover whose subject was, "Some of the Currents of Development in American Business." Tracing the various developments during the last 25 years Mr. Hoover pointed out the importance to our present prosperity of such factors as the American conception of the relations of high wages, high production and low cost; the growth of the co-operative sense, now consciously employed to further business progress; the changing ideas as to competition; the ascendancy of management over ownership in the control of business institutions, the increasing stability of finance, the growth of national efficiency and the benefits from the advance in education, scientific knowledge and leadership. A more extended abstract of Mr. Hoover's address will be published next week.

Perhaps the two group sessions of most interest to the machinery industry were the ones held by the Domestic Distribution and Manufacturing Departments.

Speaking on the subject of installment selling, O. H. Cheney, a New York banker, stated that there are few data on the subject and fewer trustworthy analyses of data. This type of selling is built on competition and may be killed by competition when buyers have committed themselves too far ahead. Surplus funds and modern competitive banking methods have done much to stimulate it. Best records available seem to come from the automobile industry where three quarters of the cars sold are on time payments. Where the down payment is too low or the time extended too long, repossessions increase amazingly fast. Other industries should not embark on installment selling until they know exactly what they are doing, how much it will cost and where it will lead them.

At the session of the Manufacturing Department, Paul W. Litchfield, president, Goodyear Tire and Rubber Co., gave an address on the "Present Attitude of Employer and Employee." Mr. Litchfield enumerated five factors that are essential to success of industry. Employees must have good health, loyalty, efficiency, co-operative spirit and thriftiness, and management must do its part in helping its men to acquire these characteristics.

"It used to be the thought," said Mr. Litchfield, "that the first thing to cut when profits began to shrink was wages. It is now recognized that this condition should be met by increased efficiency, elimination of waste, the cutting down of overheads in production and distribution, and an attempt to maintain wages by increased and more efficient production because a general cutting down of wages curtails the demand for the finished products of industry, the demand for which is the very life-blood of prosperity."

The other paper at this session was on foreman training by Cyrus McCormick, Jr., International Harvester Co. In the absence of the author it was read by A. A. Jones, manager of manufacturing of the company.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE British labor leaders have called off the general strike, and it seems likely that the coal miners will soon be at work again in pursuance of some agreement to compromise or arbitrate their claims.

The English people are to be congratulated upon the poise and self-restraint that all the parties in interest have shown.

It has been a great triumph for orderly government, and from an American standpoint it appears to negative the pessimistic talk about the decline and fall of the British Empire of which so much has recently been heard in England as well as in this country.

But the newspapers that published the cables announcing the settlement of the British Strike also carried the news of a military revolution in Poland under the leadership of a former president of the Polish Republic, and people are coming to the conclusion that the European unrest is deeper seated than most Americans supposed.

The effect upon the investment markets in this country has not been altogether tranquilizing, and a lessening of confidence in the value of European obligations is becoming apparent.

Thus when the syndicate that brought out $100,000,000 of Italian 7 per cent bonds last November was dissolved, the bonds fell six points over night and most other foreign securities have shown a declining tendency.

The settlement of the French debt has not yet been ratified by the United States Senate, and indications are that the questions at issue will remain in abeyance until the autumn.

The response of the domestic security market to the settlement of the British strike has also been somewhat disappointing. Automobile securities in particular have been weak, and the impression grows that the demand for new motor cars is disappointing.

But it must be admitted that this view is not entirely borne out by the production schedules of the manufacturing companies as most of them seem to be making more cars than they did last year and the General Motors Co. in particular reports an increased demand for its product.

The tendency toward conservatism that approaches pessimism in interpreting the business news of the country is in fact so general that it should be taken with a grain of salt in attempting to diagnose the situation.

The reactionists appear to be in the saddle, and the news is taking on the color of the prevailing mood.

As a result most of the speculative commodity markets are somewhat lower. Wheat and corn are exceptions, as the small carryover of both acts as a sustaining factor. Cotton has lost part of the advance that was caused by the heavy rains. Sugar is a shade easier because President Machado has slightly increased the maximum production legally permissible in Cuba. Coffee is neglected because the Brazilian Government controls the prices and seems unwilling to permit a decline.

Steel and iron are appreciably lower and the unfilled tonnage on order is disappointing.

In the dry-goods market distributive trade is quiet and some wholesale merchants are said to be advising hand to mouth buying.

There is an abundance of bank credit. The railroads report a record movement of staple merchandise. There is no unemployment, and the only statistics that are definitely adverse are those of our foreign trade.

For April imports exceeded exports by about 10 million dollars. This compares with an export excess of 52 million dollars last year.

For the first four months of this calendar year imports exceeded exports by about 140 million dollars, whereas the balance was 209 million dollars the other way in 1925.

It is a tradition of American business that a favorable trade balance is essential to prosperity in this country, and it may be that the figures cited above are unwarrantably affecting public sentiment. The word "unwarrantably" is used because it is idle to expect that a creditor nation can continue to sell more than it buys except as it makes the foreign loans which America now seems somewhat unwilling to grant.

But it is futile to argue with a state of mind, and there is no doubt that the dominant feeling in this country is now one of doubt and hesitation.

Most of the self-appointed prophets who assume to advise the public are predicting a general decline in the price level. Their predictions are restraining buyers with the result that inventories are being so reduced that constant replenishment is necessary. As a consequence a great many small orders are being filled from day to day. But the volume of business is not far behind last year and there is no cause for any real apprehension.

Then there is Europe. The unsettlement there has made America less willing to lend abroad, and the foreigners will be compelled to send us their goods in exchange for what they buy here.

In the competition there may be some international price-cutting, and this is probably what our business men are consciously or unconsciously afraid of. The outlook is in consequence a little beclouded, but the skies will clear if the statesmen of Europe can re-establish orderly government there, and it is to the other side of the Atlantic that American business must look for the stimulus that it now seems to require.

What's Doing in Industry

A slight change for the better is seen in the reports from important industrial centers in which machine tools and machinery find the best market. Inquiries have picked up and orders, while slow in closing and usually calling for single machines, have nevertheless reached a larger volume than during the past two weeks. Present indications are that May will show a good business, although it is admitted that the volume will fall below earlier estimates.

New England continues to forge ahead, recent developments in the auto accessory field promising increased business. Canada reports an upward trend, large construction projects affording new prospects. The New York market shows improvement, with more activity in closing on quotations.

In the Mid-Western territory conditions remain spotty. Detroit reports little change from a week ago, but there is renewed hope that the automobile trade will soon begin further expansion programs. Chicago inquiries are active, but sales are slow in closing. The outlook in Cincinnati is good, production being sustained at normal.

Sales in Indianapolis are equal to last year's, but are below expectations. The South, with much industrial expansion under way, feels assured of a good summer business in construction machinery lines.

Due to a variety of unsettled conditions in Europe, the business outlook is beclouded, but it is believed that the future holds promise of readjustment, and American business men are looking abroad for the stimulus that present conditions seem to require.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New England

A better volume of inquiries emanating from the automotive industry during the past two or three weeks has been observed, and it is believed that many of these originated because of the revision of the Canadian tariff. No one had any definite information on the subject, but it was the consensus of the majority that the tariff question had something to do with the prospective business. If the amount of business materializes New England is going to see a very active summer. Operating schedules will have to be extended and employment will have to be expanded.

The second quarter is going to show greater production, exceeding the substantial records of the first three months and in excess of the corresponding period in 1925.

Builders of power machinery for farmers are now well represented among the buyers of shop equipment. The best shipments are going to the Middle-West.

Selling agents report good business in New England and sales managers who have recently visited the trade are optimistic of the future.

Canada

The upward trend in Canadian industry is greatly benefitting machinery and machine tool dealers. Reports from all sections of the Dominion are to the effect that the commencement of spring activities has added materially to order books. Orders are expected to materialize this summer as a result of the big pulp and paper mills and power plants now being constructed in the provinces of Ontario and Quebec.

The International Paper Co. has announced that the greater part of the equipment for its paper mill and power plants at present being built in the Gatineau district of Quebec province will be purchased in Canada.

With the opening of navigation, the metal markets are securing a large amount of business in material for repair and replacement work. Bar iron and steel, special castings, plates, hardware and boiler room equipment are in good demand along the Great Lakes and on the Atlantic and Pacific coasts. The Victoria Machinery Depot reports that business this year is greatly in excess of that of 1925.

For the fourth consecutive month, building contracts awarded have shown substantial increases over those of last year. Industrial building in April was up 177 per cent, compared with April, last year.

Southern District

In spite of the fact that machinery and tool sales in the Southern district are not yet as active as the trade had anticipated most dealers express themselves as fairly well satisfied with conditions, and particularly optimistic over the late spring and early summer outlook. Sales the past two or three weeks have continued to surpass the same period last year, and since the middle of April volume of business has been slowly but surely increasing from week to week.

The lateness of the spring season has served to slow up industrial construction, so that sales to this source are not as heavy as they might have been. The industrial outlook is very good, however, as noted from the abnormal volume of inquiries the lumber industry in Atlanta is receiving. In fact, new industrial construction promises to afford the machinery and tool dealers in the South one of their most active markets this year.

The railroad outlook is particularly good, and sales are beginning to open up in this field on a good basis. Several important shop building projects have been announced by larger Southeastern railroads, and these will create an outlet for considerable heavy machinery before the end of the year.

Service station construction is also better than normal, and good sales are looked for this year in this field, though they will be largely of used and rebuilt equipment. Inquiries form this source have improved. Smaller machine shops are buying little, and inquiry small. The textile industry should be a particularly good buyer, dealers believe.

Cincinnati

Reports of Cincinnati machine tool manufacturers vary as to the market of the past week. Inquiries are still coming in from all sections of the country, and because of this there is a general feeling there will soon be a return of the normal demand. Production is still maintained at the normal level, there being sufficient orders on hand to keep the plants busy.

The greater part of the sales of the past week have been to miscellaneous concerns in the metal trades and to industrial users of tools. One concern reports a few small orders from the automotive industry, but this seems to be the only business from that field.

No section seems to have purchased more than another. Orders and inquiries received continued to be well scattered over the country and were well diversified as to sizes and types of tools. A few orders have been booked from the coal fields.

The general feeling among manufacturers and selling agents is that there is no reason for pessimism, even though the aggregate volume of sales may have dropped off slightly in the past week. The decrease was not entirely unexpected, it is stated, and it is regarded as merely a temporary lull.

New York

A slightly better feeling pervades this market this week. Increased activity in inquiries and quicker action on quotations has brought indications of a better sales volume for the month of May. Orders are mostly for single tools, some for two or three, and these of special character designed for maximum production.

One good sized order placed this week called for 25 automatic milling machines, purchased by the Singer Manufacturing Co. The list of orders placed shows a miscellaneous collection of tools. Following are a few that give an idea of the market trend: Two 20-in. shapers, two 4-ft. radial drills, two 11-in. portable lathes, two automatic milling machines, and one each of the following—heavy-duty drill, thread miller, 17-in. lathe, plain milling machine, cutter grinder, jig borer and duplex centering machine.

The used tool market is active as far as inquiry is concerned, but dealers complain of the lack of good material to draw on. Several important auction sales in the next month may correct this situation.

Detroit

No material change in market conditions in the machine tool and machinery industry in Detroit and other industrial centers of southeastern Michigan has occurred within the past week.

Sales continue to be spotty, with keen competition for all the business which happens to be falling to the lot of the machinery salesmen. Only a few automobile manufacturers are doing any buying, and even these seem to be possessed with an idea to keep purchases of new machinery down as far as possible.

In a number of the motor car plants the engineering staffs are known to have plans under way for extensions as well as replacements of equipment now getting obsolete. A few orders for replacements have been secured in the past two weeks, but the surface has only been scratched, it would seem.

Some local dealers report sales of milling machines, hobbers, reamers, grinders and other standard equipment, while the sales of small toolroom equipment has picked up slightly. There are no indications, however, that any material change for the better will take place in Detroit for at least another three or four weeks.

Construction machinery is moving fast because of the tremendous building program scheduled for this year in Detroit. There is also a better market for electrical machinery. Used tools, especially the good ones, are moving fairly well.

Employment is far above what it was a year ago, and throughout Michigan business conditions are good.

Indianapolis

Steadiness appears to be the chief characteristic of the machinery and machine tool market in this territory. The sale volume is equal to that of last year at this time, but there has not been the increase hoped for by the trade. Some industrials show a spotted condition. Many believe a very late spring has had much to do with this situation. This is particularly true as regards sales of special machinery to wood-working and furniture factories, where business has been slow.

Sales of contractors' equipment have also shown some unfavorable reaction because of the late season, coupled with the fact that building trades in many of the larger cities of the state are striking for more money. It is reported, however, that most of these strikes have been compromised and a better business from this source is expected in the next two weeks.

Indianapolis appears to be one of the few cities where automobile production is behind sales. Reports from two of the largest factories, Stutz and Marmon, show the former far behind in production and the latter just about breaking even. These factories tooled up heavily the first of the year, but are still making steady purchases.

Sales of used machinery are listed as fair. Dealers are experiencing some difficulty in locating just what the customer wants, even though the demand has not been heavy.

Chicago

Thus far in May, the machine tool industry has developed no features tending toward an increased amount of business in the immediate future. None of the large manufacturing or producing interests have come into the market recently as buyers, except for small lots. Railroads continue to make inquiry for special machines, but show no indication of an early intention of closing the lists sent out several weeks ago.

Inquiries in general are satisfactory in point of number, although the closing of sales is slow. As a general thing, the business being done by dealers in both new and used machinery may be said to be fair. Occasionally, an encouraging report of exceptional activity is given out, one concern, handling a varied line, stating that its business thus far in May has exceeded the entire month of May, 1925.

Manufacturers of milling machines are still working their plants overtime in the effort to catch up with orders. The predicted strike in the building trades having materialized last week, local business in wood-working machinery is showing a decline, this line being quick to feel the effect of a lull in the building industry.

Discuss Standards for Woodruff Keys

The first working meeting of the subcommittee on the Standardization of Woodruff Keys was held on May 12 in the General Motors Bldg., Detroit. The organization meeting was held on March 26 in New York.

At the Detroit meeting sizes up to G were considered, and a temporary list was made as a basis for discussion by all concerned. Tolerances were treated in the same manner. Copies of the temporary proposals will be distributed.

Present at the meeting were:

William J. Outcalt, of the standards department of the General Motors Corportation, elected temporary chairman.

L. C. Morrow, managing editor of the *American Machinist*, elected temporary secretary.

C. B. Le Page, secretary of the sectional committee on the Standardization of Shafting, and secretary of the A.S.M.E. Standardization committee.

E. J. Wagner and W. J. McIntyre, of the Standard Steel Specialty Co.

R. F. Dow, of the Whitney Manufacturing Co.

B. F. Waterman, of the Brown & Sharpe Manufacturing Co., also representing the American Gear Manufacturers' Association.

Carl J. Oxford, of the National Twist Drill Co., also a member of the Simplified Milling Cutter Simplified Practice Committee.

R. S. Burnett, manager of the standards division of the Society of Automotive Engineers.

R. H. Weinert, of the Studebaker Corporation of America.

First Meeting to Study Co-operative Plan

An association recently formed by American colleges and universities giving co-operative instruction in engineering, commerce and other subjects will hold its first annual meeting on June 14 and 15 at the University of Cincinnati, where the system was originated by Dean Schneider about twenty years ago.

Under the co-operative plan students spend alternate periods at the university and at work in industry. These courses have been established in many of the best known engineering colleges in the country, and representatives from these schools will attend the meeting. There will also be delegates from several large industrial manufacturers who have employed student-workers under the plan.

G. B. Crocker Elected by Southern Metal Trades

George B. Crocker, of Gastonia, N. C. who has been prominently identified with the foundry and machine shop industries in the South for many years, was elected president of the Southern Metal Trades Association at the annual convention in Macon, Ga., May 5 and 6. Other officers elected were John S. Schofield, of Macon, vice-president; J. I. Cox, of Atlanta, treasurer, and William E. Dunn, Jr., of Atlanta, re-elected executive secretary.

The following additional vice-presidents, comprising the administrative council, were elected, one from each state: Georgia, J. T. Belding; Alabama, W. D. Tynes; Mississippi, H. Y. Ray; North Carolina, N. R. McCruiston; Louisiana, Charles R. Law; Texas, E. H. Trick; South Carolina, T. H. Lindell; Florida, R. O. Collins; Arkansas, F. I. Brown. Two representatives at large were elected, A. E. Hartwell, of Houston, Tex., and G. L. Golden, of Columbus, Ga.

Men prominent in the machinery and foundry industries in the South were on the program.

Business Paper Editors Have Fifth Anniversary With Secretary Hoover

On May 10 at the Metropolitan Club in Washington the National Conference of Business Paper Editors met with Secretary of Commerce Herbert Hoover to celebrate the fifth anniversary of the inauguration of the informal dinners that have taken place every month or two since that time. Paul I. Aldrich, editor, *The National Provisioner*, presided and introduced the following speakers who addressed brief remarks to the subject, "How It Happened," E. J. Mehren, vice-president, McGraw-Hill Publishing Co., Inc.; Fred M. Feiker, vice-president, Society for Electrical Development; A. C. Pearson, vice-president, United Publishers' Corporation.

"What We Get Out of It" was told by H. C. Parmelee, editor, *Chemical and Metallurgical Engineering;* Charles J. Stark, editor, *Iron Trade Review;* and E. T. Howson, western editor, *Railway Age*, all former presidents of the conference. The usual discussion of current conditions followed.

Personals

JOHN J. C. GLESMANN, tool engineer for the past twelve years for the American Bosch Magneto Corporation, has resigned.

R. C. FELTES has been appointed manager of the Hisey-Wolf Machine Co., of Cincinnati.

OSCAR KYLIN is now associated with the Lucas Machine Tool Co., of Cleveland. He was formerly vice-president of the Foster Machine Co.

HENRY EGGELHOF, of Dallas, Texas, has been appointed exclusive sales representative in the Eastern part of Texas for the Uehling Instrument Co., of Paterson, N. J.

W. BURR BENNETT has been appointed production manager for the Maccar Truck Co., of Scranton, Pa. He was formerly manager of the American La France Fire Engine Co.

BRIGADIER GENERAL JOHN W. JOYES, U. S. A., assistant chief of ordnance, has left Washington on an extended tour of inspection of ordnance activities in the Philippines, Hawaii and Panama.

DONALD M. CROSSMAN has resigned as advertising manager for the Niles-Bement-Pond Co., after sixteen years service with the company. Mr. Crossman will sail for Europe on May 27th for an extended vacation. He will return in October.

ALBERT ROBERTS has been appointed district manager of the Southern branch of the Duff Manufacturing Co., of Pittsburgh, Pa., manufacturer of jacks. Mr. Roberts was formerly with the Grip Nut Co., of Chicago, as a sales and service engineer in the Southern territory.

DOUGLAS ANDREWS, widely-known sales executive, has been appointed sales manager of the Duesenberg Motor Car Co. Mr. Andrews has assumed his new duties with the company and is developing a sales organization. The company for years has devoted itself almost entirely to the engineering and production principles of Duesenberg cars.

GEORGE O. DESAUTELS, of Indianapolis, president of the Desautels Co., is expected home this month. Mr. Desautels has completed setting up drop forge machinery for the Lancier Co., in Torino, Italy, and for Fenwick Brothers Co., in Paris. Mr. Desautels is president of the Desautels Co., of Indianapolis, manufacturers of drop forging machinery.

W. B. DILLY, for five years superintendent of the Galt Machine and Screw Co., Galt, Ontario, and four years superintendent of Creelman's, Ltd., Georgetown, Ontario, has joined the staff of Production Materials, Ltd., Canadian representatives of E. F. Houghton and Co., Philadelphia, in the capacity of distributor for Toronto and district.

FRED G. RUMBALL, formerly branch manager of the Kansas City branch of the Timken Roller Bearing Service and Sales Co., has been promoted to the position of sales engineer, automotive division, of The Timken Roller Bearing Co. Mr. Rumball will have his headquarters at Cleveland. Mr. Rumball first joined the Timken Detroit Axle Co., and later came with the Timken Roller Bearing Service and Sales Co. The position of branch manager at Kansas City will be filled by J. M. Carey, who has been promoted from the position of salesman under Mr. Rumball.

RAYMOND F. BUCKLEY, who for a number of years has been chief engineer of the Robert H. Hassler, Inc., of Indianapolis, has been made factory manager, in complete charge of production. Mr. Buckley for the past year has been secretary of the Indiana Section of the Society of Automotive engineers. Guy H. Lemmon, who has been sales manager for the past year and under whose direction the present sales organization has been built, has been made a vice-president of the company, in charge of sales.

FULLER F. BARNES, formerly treasurer and general manager of the Wallace Barnes Co., Bristol, Conn., manufacturers of springs, has been elected president of the company to succeed his father, Carlyle F. Barnes, who died recently. Harry C. Barnes, formerly secretary, was elected treasurer, and John S. Barnes was appointed secretary. Other officers were elected as follows: Assistant treasurer and comptroller, Dwight C. Buffum; general manager, J. Ernest Andrews; plant manager, Raymond W. Cook. Directors of the company are the above officers and Lucius C. Ives, Brown Joyce, Lisle K. Lasher, William Muir, Harold B. Reid and Frank B. Tibbitts.

Obituaries

WILLIAM S. WELLS, a director and former president of the Fairbanks Co., died in Paris on May 13.

WILLIAM EDENBORN, organizer of the American Steel and Wire Co., now a part of the United States Steel Corporation, died at his home in Shreveport, La., on May 14. He was 78 years old.

J. L. MILNER, who had been Ontario manager at Hamilton, Ontario, for Arthur Balfour & Co., of Canada, steel manufacturers of Sheffield, England, for the past three years, died April 29.

PER THORSTEN BERG, one of Sweden's foremost engineers, who was at one time chief engineer for the Carnegie Steel Works, in Pittsburgh, died at his home in Stockholm, Sweden, on May 14. He was 73 years old.

HENRY F. ALBRIGHT, a director and vice-president in charge of manufacturing for the Western Electric Co., died on May 11 in New York City. He was 58 years old. Mr. Albright had a long and successful career in the field of electrical engineering

and one of his prominent achievements was the building up of the Hawthorne Works of the Western company at Chicago.

Robert Sanford Riley, noted inventor and president of the Sanford Riley Stoker Co., Worcester, Mass., died at his home in that city on May 7 at the age of 51. Mr. Riley came from Hamilton, Ont. He graduated from the Worcester Polytechnic Institute in 1896. He invented a mechanical stoker and organized the Sanford Riley Stoker Co., of which he was head at the time of his death. He was also president of the Murphy Iron Works, of Detroit, and a director of the Norton Co. of Worcester. He was a member of the American Society of Mechanical Engineers.

Business Items

The Cadillac Machinery Co., of Detroit, will move its offices on June first to 6209 Hamilton Ave.

The Cincinnati Engineering Tool Co. has opened a New York sales office at 149 Broadway. P. K. Dayton is in charge.

The Carlson Machinery Co. has been incorporated at Davenport, Iowa, to manufacture machinery and industrial equipment. H. B. Carlson is president and general manager.

The Ferguson Gear Co., of Gastonia, N. C., manufacturer of gears and mill equipment, is erecting additional buildings and considerably expanding the scope of the plant's production.

The Husky Wrench Co., of Milwaukee, has moved into a new factory and executive offices at 27th and Florence Sts. The company's export office will be continued at 280 Broadway, New York City.

The Koontz-Wagner Co. has been incorporated at South Bend, Ind., to manufacture electrical machinery and appliances. The incorporators are Harvey Koontz, Clarence F. Wagner and Frank L. Wagner.

The American Steel and Wire Co. announces the opening of a Southeastern district office in Atlanta on Marietta St., with J. W. Patterson in charge as manager. All business in the Southeast will be handled from this office.

The Continental Machine Co. has been established in Minneapolis with headquarters at 1301 Washington Ave., S. The company plans to furnish a service for inventors in marketing machines, as well as manufacturing new equipment.

The Granville Engineering Co., Ltd., of Vancouver, B. C., has purchased the plant and equipment of the Mainland Engineering Co., Ltd., 422 Railway St., Vancouver. The manufacture of marine and saw mill machinery and foundry work will be continued by the new owners.

The Power Specialty Co., of Dansville, N. Y., will take over the manufacture of the aero-pulverizer, which the company has been contracting with other firms to manufacture. This will call for increased manufacturing facilities. Ground has been broken for an addition to the machine shop and also to the foundry.

The plant and equipment of the Wood Turret Machine Co., at Brazil, Ind., which was offered for sale recently at auction, failed to sell for want of a sufficient bid. Machinery dealers of St. Louis, Chicago, Indianapolis and other cities, had representatives who offered bids on machinery, tools and other equipment, but refused to bid on the plant as a whole.

A news item published in the April 29 issue of *American Machinist*, stated that the J. J. McCable Lathe and Machinery Corporation had discontinued its New York office at 149 Broadway. This was an error. The main office of the company has been transferred to the Warehouse in Jersey City, but a sales office will be continued at the same address in New York.

The branch office of the Timken Roller Bearing Service and Sales Co., located at 1033 Cathedral St., Baltimore, was closed on May first. The service requirements of Timken customers in this territory will be supplied through the Richmond, Pittsburgh and Philadelphia branches. T. F. Rose, formerly assistant branch manager of the Chicago branch, has been appointed branch manager of the Cincinnati branch. H. C. Sauer has been appointed Detroit manager.

The Westinghouse Electric and Manufacturing Co. announces the following sales department appointments: Supervisor of development, T. A. McDowell; supervisor of costs, W. C. Koehler; supervisor mixed apparatus negotiations, C. F. Lloyd; motor apparatus, O. F. Stroman, manager, assisted by the following—large motor, R. O. Watson; synchronous motor, C. D. Kester; medium a.c. motor, J. R. Olnhausen; medium d.c. motor, C. B. Stainback; motor generator and welding, W. H. Reddie; small power motor, D. H. Byerly. For generating apparatus, H. W. Smith, assisted by: d.c. power apparatus, F. J. Lewis; a.c. power apparatus, J. A. Brown; power transformers, A. P. Bender. For traction apparatus, A. J. Manson, assisted by: heavy traction, T. C. Wurts; light traction, E. A. Palmer; propulsion, W. B. Bassett; line material, L. F. Brahmer; renewal parts, A. B. Gibson. For switchgear apparatus, R. A. Neal, assisted by: switchboards and oil circuit breakers, N. S. Taylor; automatic switching, R. F. Frenger; switchboard devices, T. S. Watts. For distribution apparatus, G. A. Sawin, assisted by: street lighting, L. A. S. Wood (south Bend); porcelain, G. I. Gilchrest (Derry); insulation, E. H. Ott; instrument, R. T. Pierce (Newark); distribution transformers, A. C. Farmer (Sharon); meters, S. A. Berger (Newark); feeder regulators, C. R. Gilchrest; protective, P. F. Squier.

Calendar of Local Meetings

National Association of Cost Accountants

Chicago. May 20. The Relation of Cost Accounting in Industrial Planning.

Milwaukee. May 21. Election of officers. What Are the Functions of the Cost Department from the Executive's Point of View?

San Francisco. May 24. Signs of Progress in Cost Accounting.

Scranton. May 25. "The Pennsylvania Corporation Taxes," by P. A. Kennedy, Pennsylvania Corporation Tax Office.

Boston. May 27. "Cost Accounting vs. Industrial Relations," by Frank J. Dunleavy; The Dunleavy Company.

Buffalo. May 27. Annual election. Financial Statement Analysis. The Use of Graphic Charts for Executives.

Detroit. May 27. Problems in Overhead Distribution.

American Society for Steel Treating

Hartford, May 20 and 21. Spring sectional meeting.

Society of Automotive Engineers

Buffalo Section. May 18. "Coincidental Locks," by C. B. Veal.

Detroit Section. May 20. "Coincidental Locks," by C. B. Veal.

Metropolitan Section. May 20.

American Society of Mechanical Engineers

Atlanta. May 20. Luncheon meeting and visit to plants of the Standard Products Co., the Liquid Carbonic Co. and the Linde Air Products Co.

Buffalo. May 25. Regular meeting. Speaker: Mrs. Lillian Gilbreth.

Portland. May 22. At University Club, Portland, Oregon. "Modern Locomotives," Speakers—Rupen Eksergian and A. T. Beuter.

Cincinnati. May 28. "Mass Production and Its Effect on Machine Tool Design," by Arthur C. Pletz, Morris Tool Co.

Western Washington. May 29. At Longview, Washington. Demonstration of city planning system, with visit to local Long-Bell Mills.

Forthcoming Meetings

American Iron and Steel Institute. Spring meeting, Hotel Commodore, New York, May 21. E. S. Clarke, secretary, 40 Rector St., New York.

Associated Machine Tool Dealers. National convention, French Lick Springs Hotel, French Lick, Ind., May 20, 21 and 22. T. W. Carlisle, Strong, Carlisle & Hammond Co., Cleveland, is secretary.

National Association of Foremen. Annual convention, Springfield, Ohio, May 25. V. H. Whipple, secretary, c/o Y. M. C. A., Dayton, Ohio.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 39th St., New York City.

Iron and Steel Exposition. Annual exhibit of fuel, electricity, machinery and safety under the auspices of the American Society for Steel Treating, Hotel Sherman, Chicago, June 7, 8, 9 and 10. Secretary, Mr. Kelly, Empire Bldg., Pittsburgh, Pa.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

THE iron market shows slight activity in spots; prices remain unchanged in most sections except Philadelphia and Chicago, where all grades dropped 50c. per ton during the past week. Scrap is moving slowly. Steel sheet prices continue to develop weakness; cutting under to the extent of 10c. per 100 lb. below published quotations on black and galvanized, is reported. Minimum on steel plates is now $1.85 per 100 lb. at mill, a drop of 5c. from the May 7 level. Shapes range from $1.90 to $2 and bars are quoted at $2 per 100 lb., Pittsburgh.

In the non-ferrous products fabricated brass and copper are firm at present levels; solder is up ⅝c. and babbitt metal, from ¾ to 1⅛c. per lb. at New York warehouses, compared with the May 1 level.

(*All prices as of May* 14)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	28.67
Basic	22.26
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.27
Basic	21.27
Bessemer	21.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.25	3.50
No. 12	2.45@2.55	3.94	3.30	3.55
No. 14	2.50@2.60	3.99	3.35	3.60
No. 16	2.60@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.65	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.75	4.35	4.35
No. 16	3.75@3.85	4.90	4.50	4.50
Nos. 18 to 20	3.90@4.00	5.05	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.20	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.35	5.10	4.95
No. 28	4.50@4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ⅛	¼	⅜	½	1	1½	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
065″	16	.19	.20	.21	.22	.23	.25	.27
083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	29	30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, ⅛, 8.25c.; ⅛, 7.85c.; ⅛ to ½, 7.35c. per lb. *Flat, ⅛@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.25
Tin, 5-ton lots, New York			65.75
Lead (up to carlots) E. St. Louis	7.60	New York	8.50
Zinc (up to carlots) E. St. Louis	6.75	New York	7.62½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	15.00	.....	16.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.12½	42.00	38½@42½
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			81.62½
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			13.62½
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00 Electrolytic 38.00 Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75@12.25	11.25	10.75@11.25
Copper, heavy, and wire	11.00@11.75	11.50	10.25@10.75
Copper, light, and bottoms	9.50@10.00	9.75	9.50@10.00
Heavy lead	6.75@7.00	6.50	6.25@6.75
Tea lead	4.75@5.00	5.00	5.00@5.50
Brass, heavy, yellow	7.25@7.50	7.25	7.00@7.50
Brass, heavy, red	9.25@9.75	9.50	8.25@8.75
Brass, light	6.00@6.25	6.00	6.25@6.75
No. 1 yellow rod turnings	8.25@8.50	8.00	7.50@8.00
Zinc	4.50@4.75	4.00	4.00@4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.45	$11.50
"A" Grade:				
IC,	14x20	9.70	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@.14	.17	.12@.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb.	3.60†	3.35	4.25‡
Linseed oil, per gal., 5 bbl. lots	.84½	.95	.87
Lard cutting oil, 25% lard, per gal.	.55	.50	48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.16621/2	.16621/2	.15871/2
Solder (½ and ½)	per lb.	.40121/2	.40121/2	.395
Cotton waste	per lb.	.13@.171/2	.13@.171/2	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	35	35	35
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.00@3.15
Coke, prompt foundry, Connellsville	per net ton		4.25@4.75
White lead, dry or in oil	100 lb. kegs		New York, 15.25
Red lead, dry	100 lb. kegs		New York, 15.25
Red lead, in oil	100 lb. kegs		New York, 16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger. Case hardened ¼x½-in., 6c. each, less 50%

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{5}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ill., Woodstock — Holmes Disappearing Bed Co.—punch press and drill press.

La., Tallulah—Southern Dusting Co., Inc., Box 216, E. Stevens, Mgr.—machine shop equipment including small lathe, drill press, oxyacteylene welding outfit, brake for sheet metal bending, etc., for maintenance and repair of aeroplanes.

Md., Frederick—Frederick Iron & Steel Co.—24 to 30 in. swing lathe and ring wheel horizontal spindle disc grinder.

Mass., Boston—W. P. Delaney, c/o S. S. Eisenberg, 46 Cornhill—tools and equipment for proposed 2 story repair and service garage. Estimated cost $150,000.

Mass., Quincy (Boston P. O.)—Norfolk Iron Works—equipment for proposed addition to plant.

O., Cleveland—Ohio Instrument Mfg. Co., 9410 St. Catherine St.—additional machinery for recently acquired plant at Norwalk.

O., Columbus — White Co., 307 South Sixth St., F. A. Schwind, Ser. Mgr.—two motor driven valve refacers and two reamers.

Ore., Portland — Pacific Properties Co., 272 United State Bank Bldg. — complete equipment for repair shop for proposed 6 story, 100 x 200 ft. public garage. Estimated cost $360,000.

Wis., Appleton — Appleton Ornamental Iron & Brass Works, 1704 East John St.—additional iron working machinery (later) for proposed 1 story, 40 x 60 ft. shop. Estimated cost $20,000.

Que., Montreal—L. O. Taillon, 200 Chambord St.—lathe, drill press, etc., for proposed auto repair shop.

Opportunities for Future Business

Ala., Sheffield—King Mfg. Co., 230 South Clark St., Chicago, Ill., manufacturers of steel-lighting standards, awarded contract for the construction of a 1 story, 140 x 480 ft. branch plant including foundry, machine and pattern shops, and a 2 story, 24 x 40 ft. office here. Estimated cost $150,000. Noted Mar. 4.

Calif., Huntington (Los Angeles P. O.)—Los Angeles Ladder Co., 1630 South Central Ave., is having plans prepared for the construction of a group of factory buildings including 120 x 120 ft. main building, 60 x 150 ft. warehouse and 60 x 90 ft. machinery building, etc. Estimated cost $40,000.

Calif., Oakland—Black & Decker Mfg. Co., 75 Fremont St., San Francisco, manufacturers of electric shop tools and equipment, has acquired a site and plans the construction of a distribution plant and shops at 10th St. and 6th Ave., here.

Colo., Denver — Mangus Metal Co., C. Bodman, 1221 Twelfth St., manufacturers of railroad supplies, brass, bronze and aluminum castings, etc., has work under way on the construction of a 180 x 182 ft. plant at 29th and Blake Sts. Estimated cost $100,000.

Ind., Michigan City—The Josam Co., is receiving bids for the construction of a 1 story, 130 x 160 ft. foundry. Estimated cost $45,000. Private plans.

La., Slidell—Canulette Shipbuilding Co., plans the construction of addition to machine shop on Bayou Vincent.

Md., Baltimore—M. A. Long, Co., 10 West Chase St., has acquired a site and plans the construction of a service station at Sisson and 26th Sts. Auto Car Sales and Service Co., 1309 Cathedral St., lessee.

Mass., Boston—W. P. Delaney, c/o S. S. Eisenberg, 46 Cornhill, Archt., is receiving bids for the construction of a 2 story 125 x 190 ft. garage on Forsyth St. Estimated cost $150,000.

Mass., Brockton—A. C. Fish, 106 Main St., is having plans prepared for the construction of a 1 story, 65 x 140 ft. repair and service garage. Estimated cost $50,000. W. F. Barlow, Jr., 80 North Main St., Archt.

Mass., Lawrence—Lawrence Gas & Electric Co., 370 Essex St., awarded contract for the construction of a 4 story, 50 x 80 ft. repair and service garage on Methuen St.

Mass., Lynn—M. Galaid, 540 Beach St., Revere, plans the construction of a 1 story, 85 x 220 ft. repair and service garage at 234 Chestnut St., here. Estimated cost $70,000. E. Earp, 333 Union St., Lynn, Archt.

Mass., Somerville (Boston P. O.) — Pilgrim Motor Co., Walnut St., is having plans prepared for the construction of a 1 story, 120 x 165 ft. repair and service garage at New Northern Artery, Felsway East. Estimated cost $80,000. E. J. MacDonald, 77 Summer St., Boston, Archt.

Mass., South Boston (Boston P. O.)—Boston Cutting Die Co., E. W. Hanson, 202 A St., awarded contract for the construction of a 1 story factory at Old Colony Ave. and Cottage St. Estimated cost $50,000. Noted May 13.

Every one of these items is reported by our authorized correspondents who are instructed to verify every item sent in. This free weekly service is published in the interests of the buyer and the seller, to bring them together and get machinery moving.

Everything possible is done to insure authenticity and timeliness.

Your co-operation is invited in helping us maintain this service at the highest efficiency.

BUSINESS NEWS DEPARTMENT
Tenth Ave. at 36th St., New York

Mass., Springfield — Westinghouse Electric & Mfg. Co., Page Blvd., awarded contract for the construction of a 1, 2 and 4 story office and manufacturing buildings. Estimated cost $150,000. Noted May 6.

Mich., Detroit — Detroit Stove Works, East Jackson Ave., awarded contract for the construction of a 2 story, 85 x 100 ft. enameling plant in connection with stove factory on Jefferson Ave. Noted Apr. 29.

Mich., Detroit—Wolverine Tube Co., 1411 Central Ave., plans the construction of a 2 story, 120 x 120 ft. addition to plant on Central Ave. Carey & Esselstyn, 602 Hoffman Bldg., Archts.

Mich., Muskegon — Shaw-Walker Co., Western Ave. and Division St., manufacturers of office furniture, awarded contract for the construction of a 5 story, 110 x 215 ft. factory. Estimated cost $250,000. Noted Mar. 25.

Mich., Muskegon Heights—Piston Ring Co., awarded contract for the construction of a 4 story, 122 x 125 ft. factory on Sanford St. Estimated cost $100,000. Noted Mar. 4.

Mo., St. Louis — Terminal R.R. Assn. of St. Louis, Union Station, awarded contract for the construction of shops and storage buildings at 2035-2039 Clark Ave. H. J. Pfeifer, Ch. Engr.

Neb., Omaha — Metropolitan Utilities Dist. will readvertise for bids for the construction of a garage and service station at 20th and Center Sts. Estimated cost $275,000. J. Latenser & Sons, 732 Peters Trust Bldg., Archt. Former bids rejected. Noted Apr. 29.

N. Y., Buffalo—General Electric Co., Electric Bldg., awarded contract for the construction of a 1 story, 122 x 184 ft. addition to factory. Estimated cost $100,000.

N. Y., Olean—Clark Bros. Co. awarded contract for the construction of a 100 x 200 ft. machine shop, 100 x 126 ft. foundry and 40 x 90 ft. tool building, all 1 story.

O., Cleveland—Lindsay Wire Weaving Co., H. L. Lindsay, Pres., 14205 Aspinwall Ave., awarded contract for the construction of a 2 story, 52 x 165 ft. addition to factory on Manchester Ave. Estimated cost $100,000. Noted Apr. 8.

O., Cleveland — Rickersberg Brass Co., D. L. Rickersberg, Secy. and Treas., East 37th St. and Perkins Ave., soon awards contract for the construction of a 1 story, 120 x 236 ft. factory and a 60 x 200 ft. foundry on Kelly Ave. Estimated cost $150,000. Christian, Schwarzenberg & Gaeda, 1900 Euclid Bldg., Archts.

O., Youngstown — E. W. Leedy, Stambaugh Bldg., awarded contract for the construction of a 6 story, 107 x 161 ft. garage. Estimated cost $300,000.

Pa., Fox Chase (Philadelphia P. O.) — John J. Nesbitt, Inc., c/o Ballinger Co., 12th and Chestnut Sts., Philadelphia, Archt., manufacturers of ventilators, will soon award contract for the construction of a 1 and 2 story, 182 x 193 ft. plant at Rahn St. and State Road, here.

Pa., Meadville — Hookless Fastener Co., manufacturers of metal fasteners, is receiving bids for the construction of a 3 story, 60 x 300 ft. and 2 story, 50 x 200 ft. factory buildings. Wilbur, Watson & Associates, 4614 Prospect Ave., Cleveland, O., Archts. and Engrs. Noted Apr. 22.

Pa., Philadelphia—Olney Foundry Co., 180 West Ducannon Ave., awarded contract for the construction of a foundry.

Pa., Philadelphia — Soabar Co., 4608 Edmund St., manufacturers of price marking equipment, will soon award contract for the construction of a 1 story, 107 x 110 ft. factory at Endrick and Wissinomming Sts. Lockwood Greene & Co., 100 East 42nd St., New York, N. Y., Archts.

Pa., Sharon—Westinghouse Electric & Mfg. Co., Walnut and 30th Sts., Philadelphia, plans the construction of a 5 story, 70 x 220 ft. addition to plant here. Estimated cost $250,000.

Wis., Madison — International Harvester Co., 606 South Michigan Blvd., Chicago, Ill., awarded contract for the construction of a 1 story, 120 x 132 ft. service station, here. Estimated cost $70,000. Noted Apr. 29.

Ont., Kitchener — Roffmann Rim Corp., Erie Bldg., Cleveland, O., plans the construction of a plant, here.

Que., Limoilou — Quebec Power Co., Power Bldg., Montreal, will soon receive bids for the construction of car repair shops here. Estimated cost $500,000.